Power Engineering

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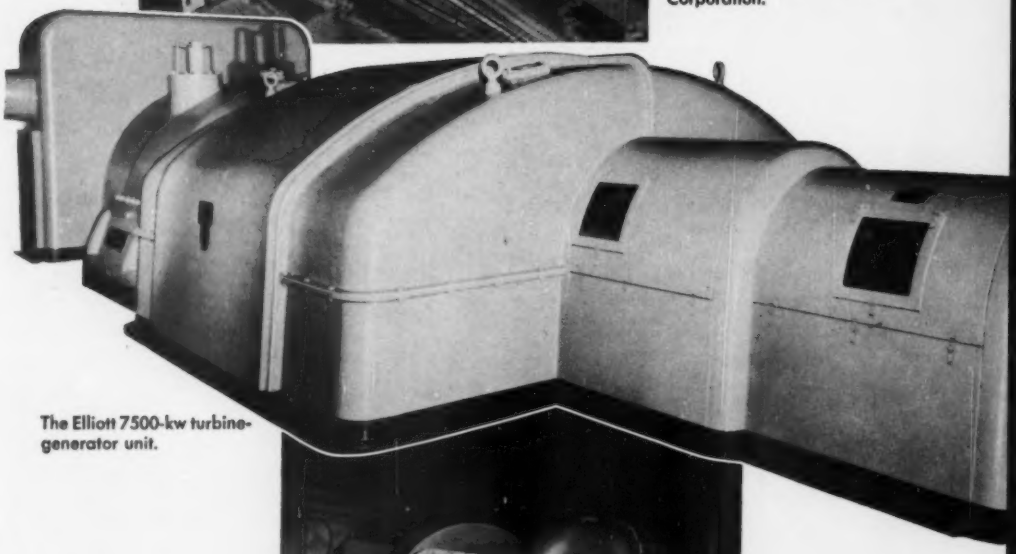
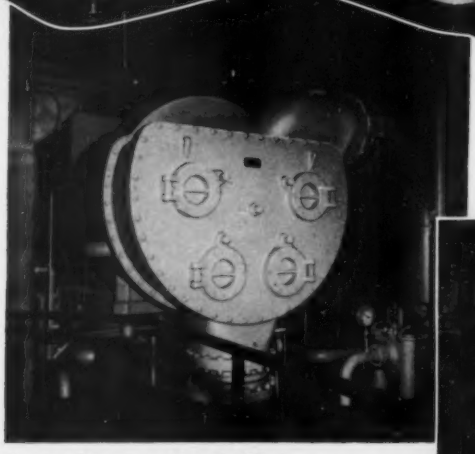
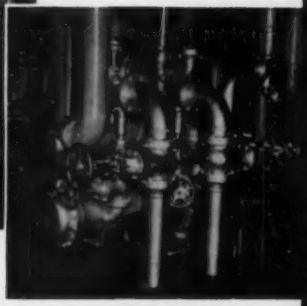
The new Caribou, Maine, station of the Maine Public Service Company. Design, purchasing, expediting, and construction by Stone & Webster Engineering Corporation.



The Elliott 7500-kw turbine-generator unit.



Serving the main turbine, the Elliott two-pass surface condenser.



Close-up of the Elliott twin two-stage steam jet air ejector.

MAINE goes ELLIOTT!

. . in the new Caribou Steam Plant, Aroostook County

The full Elliott slate takes office in this recently completed Maine Public Service Company station, located at Caribou, and serving 3600 square miles of northeastern Maine, and parts of adjoining New Brunswick. Turbine-generator, condenser, air ejector, deaerating heater, and a raft of motors driving auxiliaries, all are of Elliott design and manufacture. The Caribou diesel plant, formerly the mainstay of power needs in the territory, has Elliott generators on the two larger of its four units, two Elliott turbochargers, and Elliott twin oil stainers and tube cleaning equipment.

It is our firm belief that conservative down-East estimation of true values for which the State of Maine is noted was used in the selection of equipment for this new station.

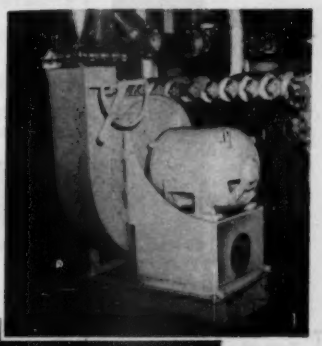
ELLIOTT Company

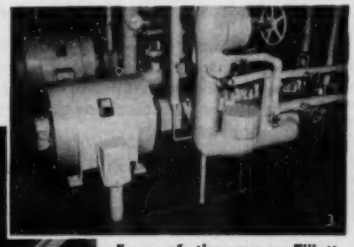
JEANNETTE, PA.

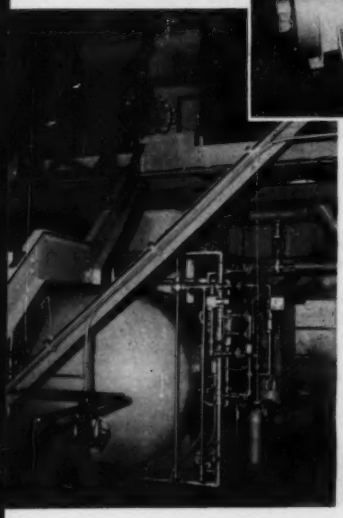
Plants at: JEANNETTE, PA. • RIDGWAY, PA. • AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.

DISTRICT OFFICES IN PRINCIPAL CITIES

Q-1157







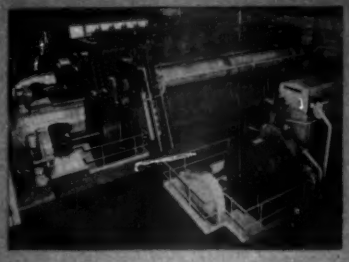
Four of the many Elliott Crocker-Wheeler motors in auxiliary service:

(1) A 20-hp 3600-rpm a-c motor driving the overfire fan.

(2) An Elliott Crocker-Wheeler Sealedpower motor, 15 hp, 585 rpm, driving the transfer oil pump.

(3) Two 200-hp 3550-rpm squirrel-cage induction motors on boiler-feed pumps.

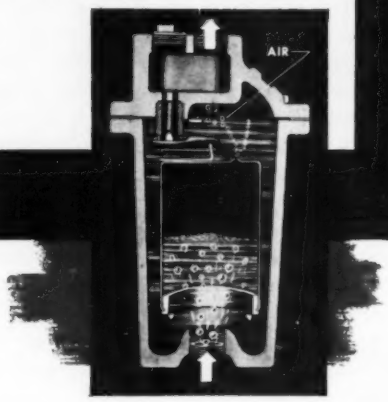
At left: The Elliott 100,000-lb-per-hr deaerating feedwater heater.



• THE CARIBOU DIESEL PLANT was hurriedly built when hydro power became inadequate. The two larger of its four units have Elliott generators, the two smaller units have Elliott turbochargers.

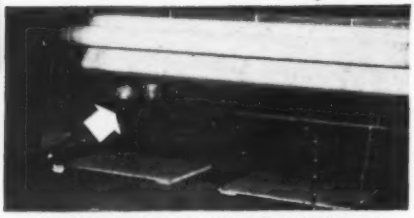
Armstrong traps vent air to give you hotter machines

HIGHER TEMPERATURES MEAN MORE OUTPUT



PSIG	Temp. of Steam with No Air Present	Temperature of Steam Mixed with Various Amounts of Air. (Per Cent Air by Volume)		
		10%	20%	30%
10.3	240.1	234.3	228.0	220.9
25.3	267.3	261.0	254.1	246.4
50.3	298.0	291.0	283.5	275.1
75.3	320.3	312.9	304.8	295.9
100.3	338.1	330.3	321.8	312.4

THIS TABLE TELLS THE STORY. You can't get the maximum temperature you need unless you get the air out.



PYROMETER TESTS SHOWS 30° TEMPERATURE INCREASE on flatwork ironer rolls at *Peter Bent Brigham Hospital, Boston, after installation of Armstrong traps which vent air along with condensate.*

EVERY time an Armstrong steam trap opens there is a momentary pressure drop which "pumps" air down to the trap from the unit being drained. The air passes through the bucket vent and accumulates at the top of the trap to be discharged along with condensate each time the valve opens.

This one basic benefit of the Armstrong trap is saving industry thousands upon thousands of dollars through faster heat-up and higher, more uniform temperatures with resultant greater output and time and labor savings.

You can have this benefit. The cost of Armstrong traps is small in relation to the efficiencies they effect. Call your nearby Armstrong Representative today.

ARMSTRONG MACHINE WORKS
810 Maple Street • Three Rivers, Michigan

SEE OUR CATALOG IN SWEET'S or C&C

HOW TO SELECT the right trap for each application, installation pointers, prices, capacities, other facts and figures are contained in the 36-page **STEAM TRAP BOOK.** Send for your copy.

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Power Engineering

Combining POWER PLANT ENGINEERING and POWER GENERATION

This magazine was established in 1896 as Practical Engineer. The title was changed to POWER PLANT ENGINEERING in 1918; to POWER GENERATION in 1948; and to POWER ENGINEERING in May, 1950. Rights reserved to above titles

February, 1952

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World's first production of electric power by nuclear energy attained on December 20, 1951 at the National Reactor Testing Laboratory in Idaho. This is an illustrated article showing the equipment used, and describing its operation

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By George S. Emmerson
This is the first of several articles on the general subject of oil contamination of boiler feedwater. In this article the author describes how oil gets into feedwater and discusses the effects of different varieties of oil. This is a subject of particular importance to industrial power engineers concerned with the return of condensate from factory processes

Midwest Power Conference Renamed American Power Conference 59

530 hp in Diesel Pumps Adds 2000 hp to Great Northern's Hydro Power 60
Here is a description of a small industrial development that typifies Yankee ingenuity at its best. Engineers of Great Northern Paper Co., Millinocket, Maine, needed more power pending completion of a new hydroelectric plant. So they put in 530 hp in diesel engines to pump water from one lake into another and thus picked up 2000 hp in hydro power. This article shows exactly how they did it

St. Louis Museum Seeks to Preserve one of Largest Steam Engines 61

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By H. F. Storm
Here is a description of an exciter for an alternator that has no moving parts and no electron tubes. It combines in one static device the function of exciter and voltage regulator

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Relativity in Power Plant Economics 66
Readers of Mr. Rowse's article What Will Future Steam Power Plants Cost? in the February 1951 issue will want to study his present article carefully. It analyzes differences in cost per kwh for 8 different steam cycles, at 1951–52 price levels, and shows an accurate, simple method of calculating and evaluating them. With costs what they are today and need for more kwh per dollar, here is a subject of vital importance for both designer and operator

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The only magazine devoted exclusively to the engineering interests and practical problems of power engineers

Industry looks to
Powell for the latest
in valve design
When new methods and processes create new flow control conditions, Powell is always ready with valves of correct design and materials to meet them.
That is why there are more kinds of Powell valves in service today than any other make.
The Wm. Powell Co.
Cincinnati 22, Ohio
Fig. 16003 W. E. 600-pound, Cast Steel Pressure Seal Gate Valve with welding ends. A Powell design for the modern Power Plant.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1846

ENGINEERS' PREVIEW

EQUIVALENT VALVES MANUAL — Another revision of the Equivalent Valves Manual was scheduled for publication January 20, 1952. This edition will contain, for the first time, sizes for cast iron and bronze valves.

This manual was first described in *Engineers' Preview,* POWER ENGINEERING, December, 1950, page 8. It is the book that gives information, checked by leading manufacturers, showing what valves are "equivalent" for a given type, material and pressure rating. This is very useful when specifying and purchasing on an "or equal" basis, or when certain items are in short supply and "equivalents" will meet the requirements.

The Manual is a 170-page loose-leaf book. It is now published and sold by Equivalent Valves Co., P. O. Box 816, Station B, Los Angeles 44, Calif. Get prices (with and without revision service) and copies direct from the publisher. We do not sell the book, so please do not send us money nor orders for it.

★ ★ ★

THIS seems to us a most interesting time-saver: — New and uniquely time-saving graphite lead drawing instrument is Castell Locktite No. 9600 holder, with a specially imported Castell No. 9040 *flat, very thin drawing lead.*

This combination is said to permit the drawing of continuous straight lines of positive uniformity. No sanding or sharpening is ever required. Held firmly in patented internal sections, the imported Castell lead measures 0.017 to 0.018 in. in thickness by 0.096 to 0.098 in. in width, with a length of 4 in. It is available in degrees HB, F, H, 2H, 3H, 4H, 5H, 6H, 7H, 8H and 9H.

Well, why not? Haven't carpenters' pencils always been flat lead?

We are well aware that there are two schools of thought on pencil points among draftsmen — the chisel point and the round sharp point. For every good exponent of one, we can show you an equally expert practitioner with the other. However, if you are a draftsman or have draftsmen under you who like the flat chisel point, you might like to look into this. We'll send you the manufacturer's name and address on request to the *Engineers' Preview* editor.

★ ★ ★

RETURN to the use of horn loudspeakers, such as were used in the early days of radio, was advocated by an audio engineer before the National Electronics conference.

Engineer P. B. Williams, of a Chicago loudspeaker manufacturer, explained that cone loudspeakers used in today's radios are economical but definitely limited in fidelity where a large amount of sound is desired. Using horn-loaded speakers achieves high efficiency, lower distortion and smoother response.

A new type of horn loading enclosure, to convert today's cone speaker into an effective horn, was described. The enclosure can be made in the home workshop and will not look like the horn speakers of old, Williams promised.

WORLD'S most powerful wind tunnel drive — a 250,000 hp unit capable of creating supersonic blasts of air — is being constructed in Schenectady, N. Y., by G. E. Rated officially at 250,000 hp, the drive will have a peak one-hour output of 300,000 hp, according to G-E engineers. The drive will consist of four 37,500-hp and three 33,334-hp variable speed, a-c induction motors linked with two axial-flow compressors.

Four of the motors will be mounted in tandem on a single shaft operating one compressor, while the remaining three will operate the second compressor. Peak wind velocities will be obtained by operating the compressors in tandem.

★ ★ ★

MEN who have helped to build the largest power plant at Grand Coulee Dam during the last 11 years initiated the start of the last 108,000-kw generator there in ceremonies on September 14. Charles A. Jinker, a 57-year-old workman with 44 years of experience for Westinghouse Electric Corp., represented the firm that has built the 18 world's largest waterwheel generators. Abel Lester represented the factory of the Newport News Shipbuilding and Dry Dock Co., builder of the 18 hydraulic turbines.

Both of the men have been at work in the factories for the past 11 years, spending part of their time making the equipment that went into the Grand Coulee generators and turbines.

In addition individual men were selected to represent the two firms on the job at Grand Coulee and to represent the Bureau of Reclamation crews which installed the turbines and which now are operating the completed generators.

★ ★ ★

THE seas are full of fish, but only a relatively few are now caught for human consumption. By applying imaginative engineering to the fishing industry it may be possible to supply fish protein to large segments of the population who cannot now afford it, and at the same time make fishing a more dependable, hence more profitable, industry. To this end, says the *Industrial Bulletin,* a new non-profit organization, the Marine and Fisheries Engineering Research Institute, has been established at Woods Hole, Massachusetts. The Institute will provide oceanographers with a means of trying out practical ideas which grow from basic research, and will give fishermen help comparable to that offered farmers by the agricultural experiment stations.

★ ★ ★

UNDERWATER television may be used by the Navy to protect as well as aid human divers in their work, says Rear Admiral Homer N. Wallin, Chief of the Navy Bureau of Ships. Television cameras can explore undersea areas to help divers spot and prepare for dangerous situations, Admiral Wallin points out. In addition, the cameras may be used to observe the work of divers, making possible shipboard coordination of underwater activities.

MANY SMALL PLANTS impede production because they are "string savers," Frank K. Shallenberger, associate professor of industrial management, Graduate School of Business, Stanford University, told the annual ASME meeting. Poorly planned plants cluttered with miscellaneous "junk," and hampered by antique equipment make good shop housekeeping impossible, he said, laying the blame on over-conservative and unimaginative management.

Small plants of less than 50 employees comprise more than 80 per cent of manufacturing plants in the country. Their part in defense mobilization will depend on their productivity, a problem of manpower, plant and equipment, and management.

Professor Shallenberger deplored the haphazard selection of employees in most small plants. He said they should be selected by the owner-manager himself. The management competence of the owner-manager is the greatest single factor in the success of the company, he said, adding that in most small plants "the first training problem was that of training the boss."

★ ★ ★

MORE THAN half the serious and fatal accidents which occurred in connection with freight elevators during 1949 and 1950 could have been prevented by adequate safety devices which are available and required by elevator codes, it is indicated by the fourth Accident Report recently published by the Otis Elevator Co. A statistical analysis of 1674 accidents reported during the two-year period, the Accident Report also includes practical data on the causes of accidents on passenger elevators, moving stairways, automatic elevators and dumbwaiters.

Compiled by Gavin Watson, assistant to the chief engineer of Otis Elevator, the analysis covers accidents on all types and makes of vertical transportation equipment installed in commercial, industrial, business, institutional and residential buildings. If you can use a copy, write the *Engineers' Preview* editor.

★ ★ ★

SPIRATUBE is a new flexible fabric tubing for ventilation and product handling. It is offered with vinyl plastic coating, which gives good abrasion resistance for rough handling, and inertness to chemicals and oils. Its light weight and accordion-like retractability make handling or shipping easy. It is non-kinkable and will not collapse under average fan suction pressures.

Basic patented construction principle consists of preformed, continuous, spring wire ribbing, which is overlapped with spirally-wound woven fabric of several alternate types. After fabrication, the tubing is coated with a Geon latex, providing the abrasion and chemical resistance.

Designed initially as ventilation tubing for the U. S. Navy, Spiratube is easily adapted to the conducting of air and other gases, many solids, liquids at low pressure, all under a variety of service conditions.

Connecting or coupling sections of tubing together is done easily and tightly with an exclusive Flexible belt clamp.

★ ★ ★

ALCO *Products Review*, a new magazine devoted to the design and installation of heat exchangers, pressure vessels and pipe for the oil refining, chemical and power industries, was published November 15 by the Alco Products Division of the American Locomotive Co. The magazine, which is an 8½ by 11 in. two-color format, features in its first issue a technical article on feedwater purification at the Hickling Station of the New York State Electric and Gas Corp. at East Corning, New York. Other articles describe aircooler selection factors and assembly-line fabrication of aircraft engine containers. Picture stories of heat exchanger and pressure vessel installations in the petroleum refinery field are included. The *Alco Products Review* is issued by the Public Relations Department of the American Locomotive Co. at Schenectady, New York.

★ ★ ★

SUPER-SENSITIVE type of glass that can be worn like a GI "dog-tag" has been discovered to be a reliable, precise detector of atomic radiation. Measuring about 1 in. square, the glass "dosimeter" is being developed by U. S. Navy scientists with the assistance of chemists at Bausch & Lomb Optical Co. When exposed to high energy radiation — commonly called X and gamma rays — the clear, colorless glass, which contains appreciable quantities of dissolved silver, remains unchanged in appearance under ordinary light, but reveals the extent of exposure by the amount of orange fluorescence it emits when viewed under "black-light" (ultra-violet). As a result, precise treatment, depending on the degree of exposure, can be prescribed immediately or weeks after exposure to the rays.

★ ★ ★

AT THE Chemical Industries Exposition, Knapp Mills, Inc., announced two new metals, which can drastically reduce the monumental waste caused annually by sulphuric acid.

First is Ferrolum, which is made by inseparably bonding lead and steel in such a way that the finished product combines lead's unique immunity to sulphuric acid with steel's strength.

Second is Cupralum, which is made by inseparably bonding lead and copper, retaining the best features of both metals, particularly lead's acid resistance and copper's high electric conductivity and heat transfer value.

In addition to the countless ways these two metals can be used to supplant inadequate materials in current use on standard equipment, it is expected that they will have widespread use throughout the burgeoning nuclear industries to prevent the escape of harmful radiation.

★ ★ ★

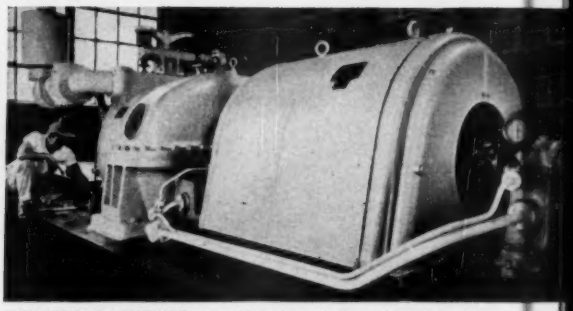
A BITUMINOUS coal company has just put to work the largest power shovel in the world! This gargantuan shovel stands higher than a 12-story building, and weighs more than a Navy destroyer. It scoops up a chunk of earth as large as a one-car garage, and can dump it 240 ft away!

This shovel works with two companions that are almost as large. Together, they peel off layers of earth and limestone 80 ft deep to reach the underlying coal seams. And they do it so fast that the coal can be mined at a rate of 250,000 tons per month. Then, in areas where coal is mined out, the land is reclaimed by planting grass and trees and creating new inland lakes.

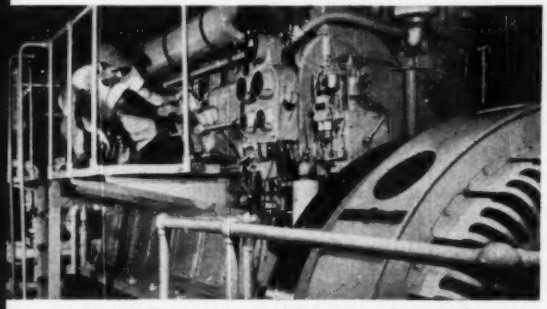
NANTUCKET ISLAND can't tie in with mainland power facilities and must therefore be entirely self-sufficient. To assure unfailing performance, the Nantucket Gas & Electric Company uses Sun lubricants exclusively. Also, engineers of the utility, of the diesel builders, and of Sun Oil cooperated to make possible a unique, three-way use of one inexpensive Sun fuel.

HOW SUN PROTECTS NANTUCKET'S POWER

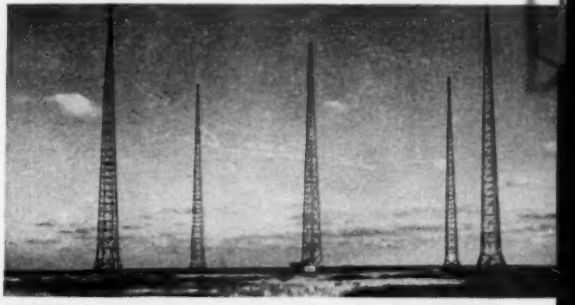
THE ISLAND'S POPULATION drops from around 16,000 to some 3,800 when the vacation season ends. With the power load fallen off so drastically, much of NG&E's equipment lies idle and subject to condensation during this extended time.



DESPITE IDLENESS for considerable periods, turbine journals, bearings and controls remain free at all times of sludge, rusting and corrosion—thanks to the protection of Sunvis 916. Its special metal-wetting additives displace any moisture that may be present.



A SUN DIESEL LUBRICANT has kept this 1,000-hp engine purring almost 15,000 hours. A single heavy, low-cost Sun fuel drives NG&E's diesel, fires its boilers, enriches its illuminating gas.



POWER for a new navigational transmitter, throwing a 1,700-mile beam for guiding aircraft, is supplied by Nantucket G&E—more evidence of the reliance placed on its Sun-lubricated plant.

For complete information about Sun's turbine and diesel oils, or for the services of a Sun representative, call the nearest Sun Office, or write to Dept. PP8

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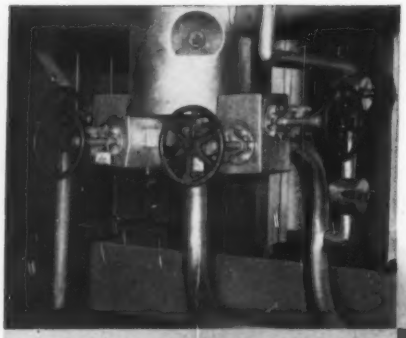
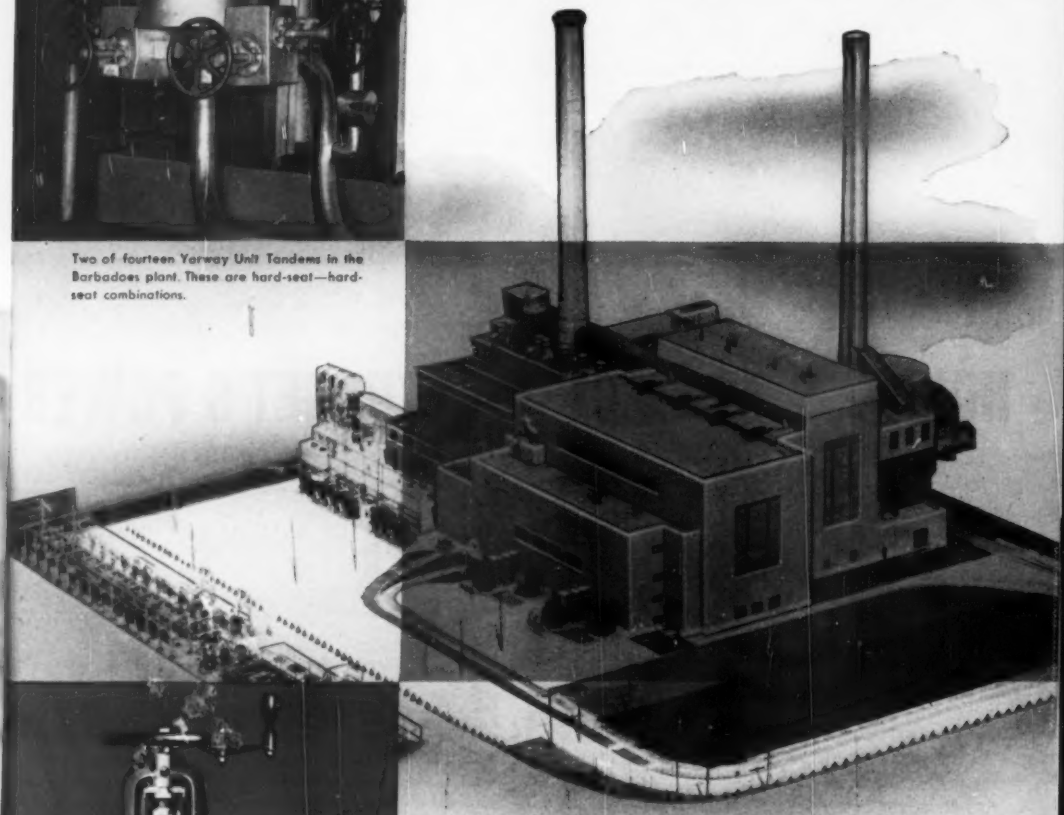
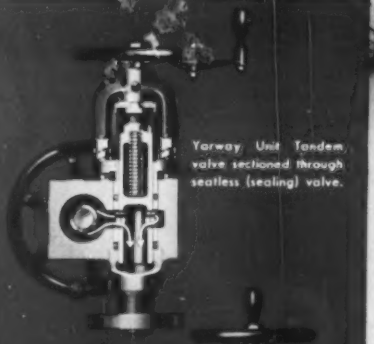


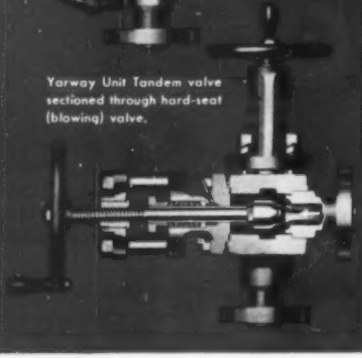
Two of fourteen Yarway Unit Tandems in the Barbadoes plant. These are hard-seat—hard-seat combinations.

BARBADOES BOILERS GET





Yarway Unit Tandem valve sectioned through seatless (sealing) valve.



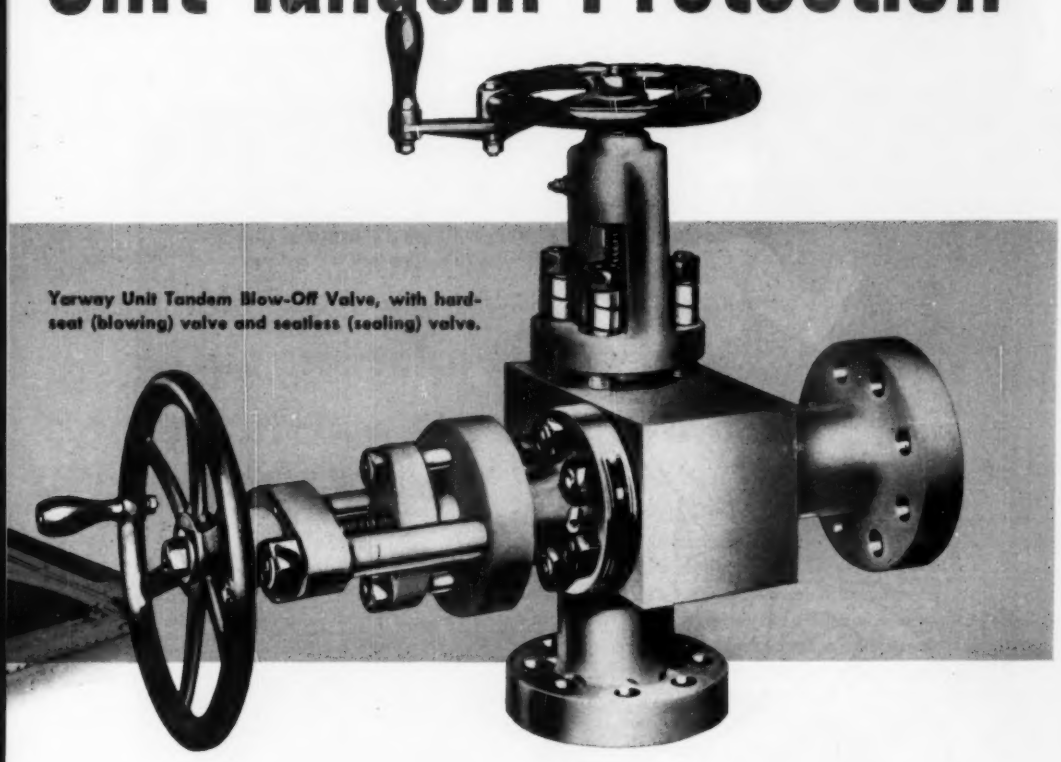
Yarway Unit Tandem valve sectioned through hard-seat (blowing) valve.

■ When a company has a $25,000,000.00 stake in the future such as Philadelphia Electric Company does in its Barbadoes Station —then protects the boilers of that plant with Yarway Unit Tandem Blow-Off Valves—it's significant of the dependability of those valves.

Barbadoes is a fine example of modern power plant engineering, demonstrated by the fact that only 11 men per shift are needed for operating this 180,000 KW station.

YARWAY

Unit Tandem Protection



Yarway Unit Tandem Blow-Off Valve, with hard-seat (blowing) valve and seatless (sealing) valve.

Yarway Unit Tandem Blow-Off Valves also are a good example of steam equipment engineering—used in more than 4 out of 5 high pressure boiler plants in the country.

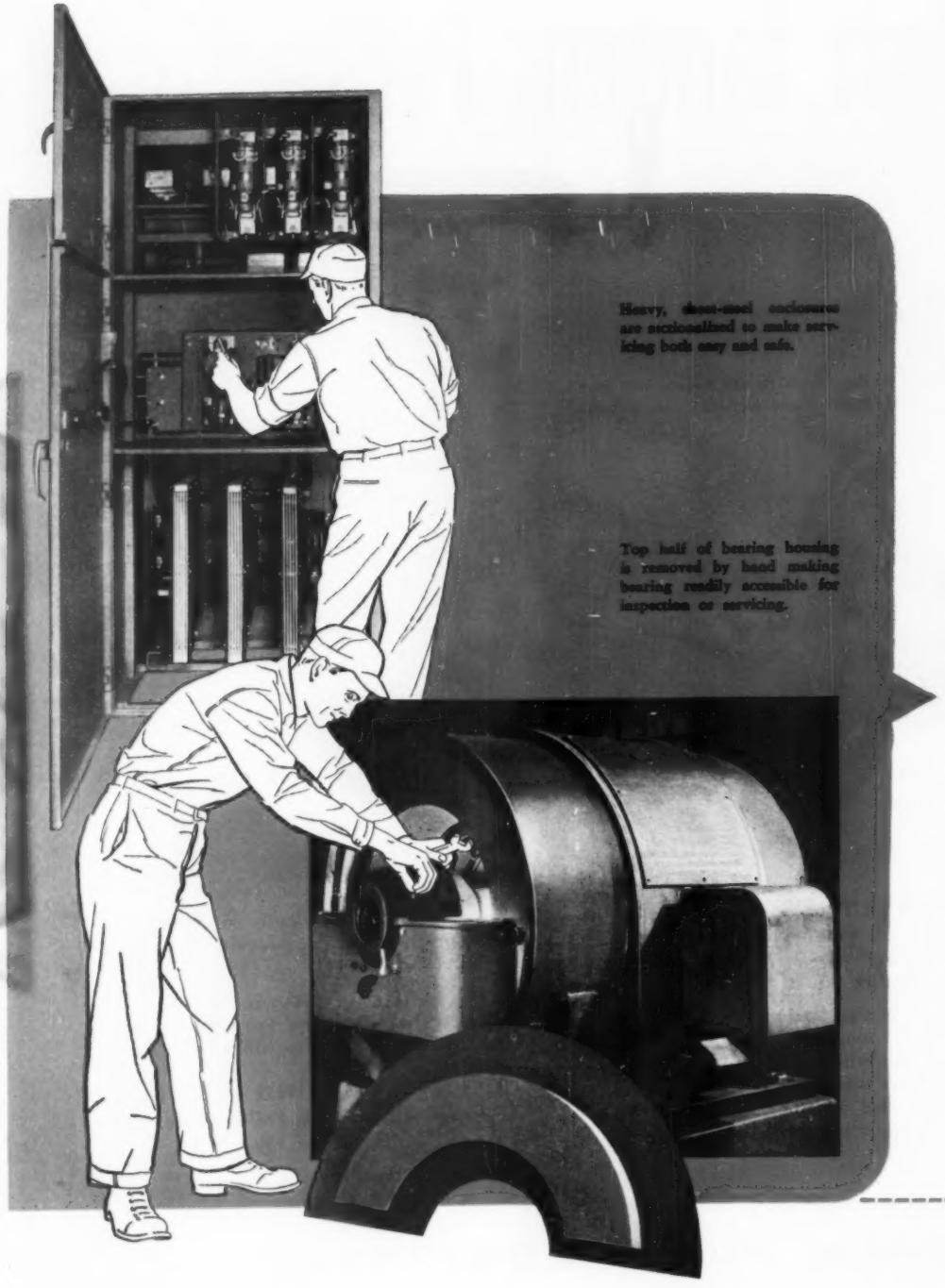
Rugged construction makes Yarways strong and tough enough to withstand severest blow-down conditions. Metallurgical improvements make them resistant to the reactions of periodic acid wash. *Outages are rare where Yarway boiler valves are used.*

Unit tandems are available in various combinations to meet all pressure and service requirements.

Write for Bulletin B-433 for full details on Yarway Unit Tandems. For lower pressure blow-off valves, write for Bulletin B-424.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

STEAM PLANT EQUIPMENT


Heavy, sheet-steel enclosures are sectionalized to make servicing both easy and safe.
Top half of bearing housing is removed by hand making bearing readily accessible for inspection or servicing.

This matched pair reduces servicing time to minutes

Every servicing operation from checking bearings to replacing contacts takes a minimum of time—without the usual muss and fuss—on this motor and control team. All components are functional in design and easy-to-get-at. No special tools are required.

On Westinghouse Large Induction Motors you simply remove the top half of the bearing housing by hand and the bearing is accessible for inspection and servicing. No top bracket to remove—no crane to lift heavy, cumbersome parts. One man and a few minutes is all that it takes.

One man can remove the motor's light, sturdy sectional covers and air shields by hand also. Here again, no crane is required—complete operation can be performed in a matter of minutes.

An occasional look in the door meets most of the servicing requirements on this Westinghouse High-Voltage Starter with air-break contactor. Simple, dependable design assures long mechanical life of the contactor and its moving parts.

Powerful magnetic blowouts and large arc boxes effectively confine arcs—increase contact life. Built-in fuses are readily accessible . . . easy to install or replace.

Westinghouse Large Induction Motors and High-Voltage Starters are the perfect power partners. Get the benefits of their co-ordinated operation. Call your local Westinghouse representative now for complete details. Or, if you prefer, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-10357

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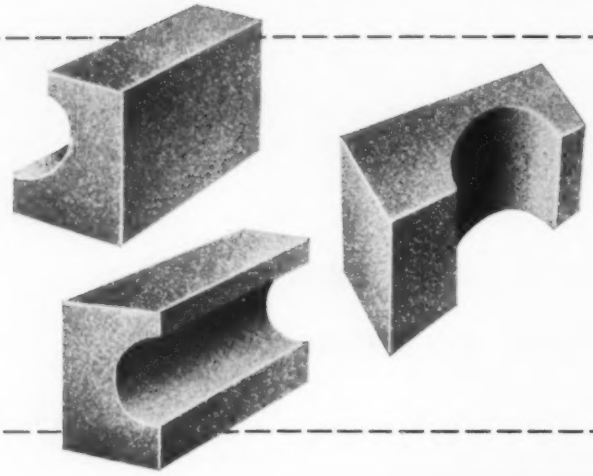
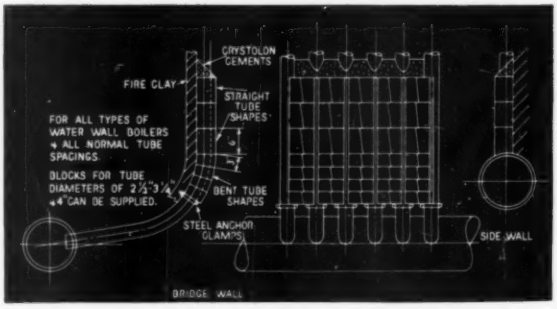
MOTORS and CONTROLS

LASTING, LOW-COST PROTECTION
for Your Water Tube Boilers
with CRYSTOLON* Armor Blocks



Made Of Top-Quality Silicon Carbide, Norton CRYSTOLON Armor Blocks have the necessary refractoriness to withstand today's extremely high boiler furnace temperatures. Equally important is their high resistance to slag penetration and abrasion. Due to their high thermal conductivity, they promote even heat distribution, and afford maximum protection to tubes from localized heat generation and flame impingement.

Installation Is Easy And Inexpensive, thanks to the simplified design of CRYSTOLON Armor Blocks. Adjoining surfaces of blocks are tapered, for secure locking and to maintain intimate contact with the tubes. Available for both bent and straight tube sections, these blocks can be replaced entirely from the fire side of the boiler. They are laid dry, further reducing installation costs, and tubes require no cleaning or grinding, as when cast iron blocks are replaced. When small areas are to be protected against flame impingement, blocks can be held correctly in place by clamps fitted around the tubes.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BLOCKS FOR TUBE DIAMETERS OF 2½"-3¼" & 4" CAN BE SUPPLIED.
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Whatever type or make of water tube boilers you're using, you can depend on CRYSTOLON Armor Blocks for thorough protection and economy. For prices and full information, send data on tube diameters, tube spacing, radius of curvature in bent-tube sections, and dimensions of areas to be covered. Refractories Division, NORTON COMPANY, 616 New Bond Street, Worcester 6, Mass.

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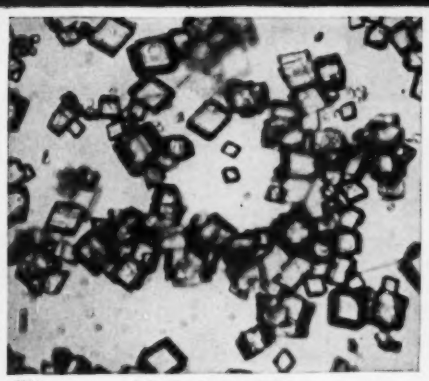
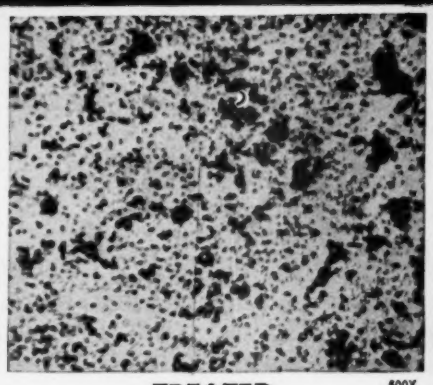


500X

UNTREATED

Note large crystal size



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BOILER SLUDGE CAN FORM SCALE . . . because of its inherent tendency for adhering to heat transfer surfaces.

The dispersive property of Allis-Chalmers No. 26 Treatment prevents crystal growth and produces a fluid sludge, readily removed by blowdown.

To you, the engineer, this means cleaner boilers — boilers that seldom if ever require turbining or other forms of cleaning. No. 26 Treatment does not soften the water, but it can be mixed with softening chemicals (if desired) without reducing its effectiveness as a sludge conditioner. This simplifies its application and reduces your investment in feeding devices.

A COMPLETE, BRIEF discussion of the Allis-Chalmers No. 26 Series organic sludge treatment is available in our bulletin number 2[illegible] (Coupon below for your conven[illegible]

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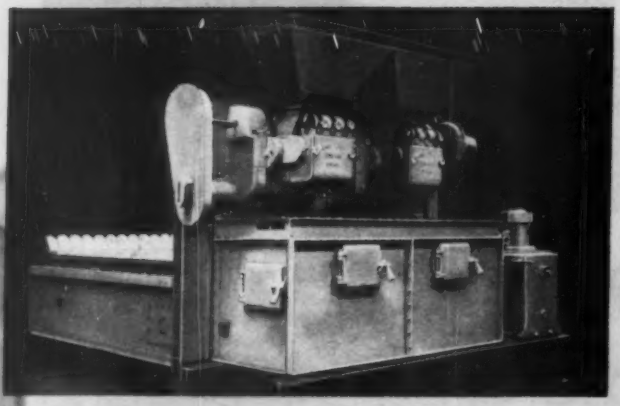

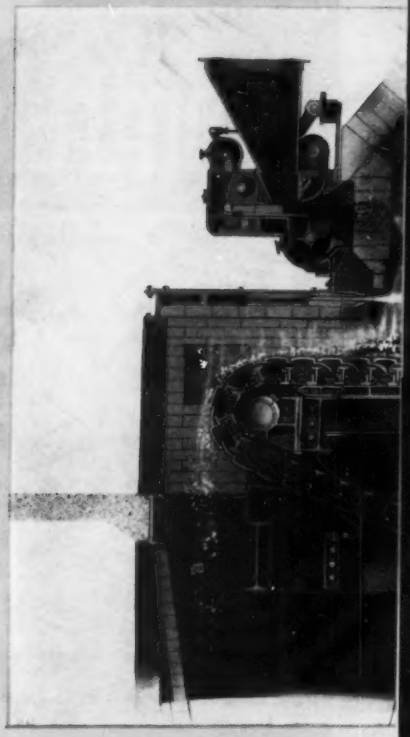

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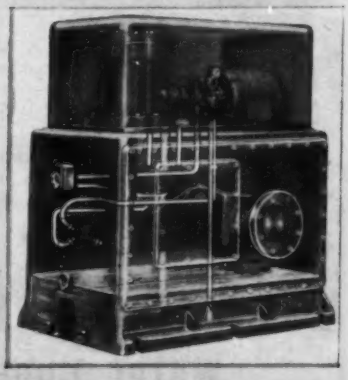
The Erie City TRAVAGRATE Spreader Stoker, for continuous ash discharge operation, is the latest addition to the Erie City Stoker line. It incorporates simplicity, easy regulation and rugged construction. Among the many TRAVAGRATE features are: Selective feeder speed for wide ranges of fuel size and consist; flexible fuel control to assure proper distribution to all parts of the moving grate; a range of grate speed satisfactory for all loads and infinite speed selection between zero and maximum rate of travel. For the complete Erie City Spreader Stoker story write for catalog SB42-E,

A Compact Hydraulic Unit drives the TRAVAGRATE

The self-contained hydraulic drive unit is contained in a single housing without external piping. The fluid drive transmits power to the main drive shaft through a linkage and ratchet gear. A single control valve regulates speed. The drive requires no shear pins since the relief valve opens to protect the equipment should the need arise.



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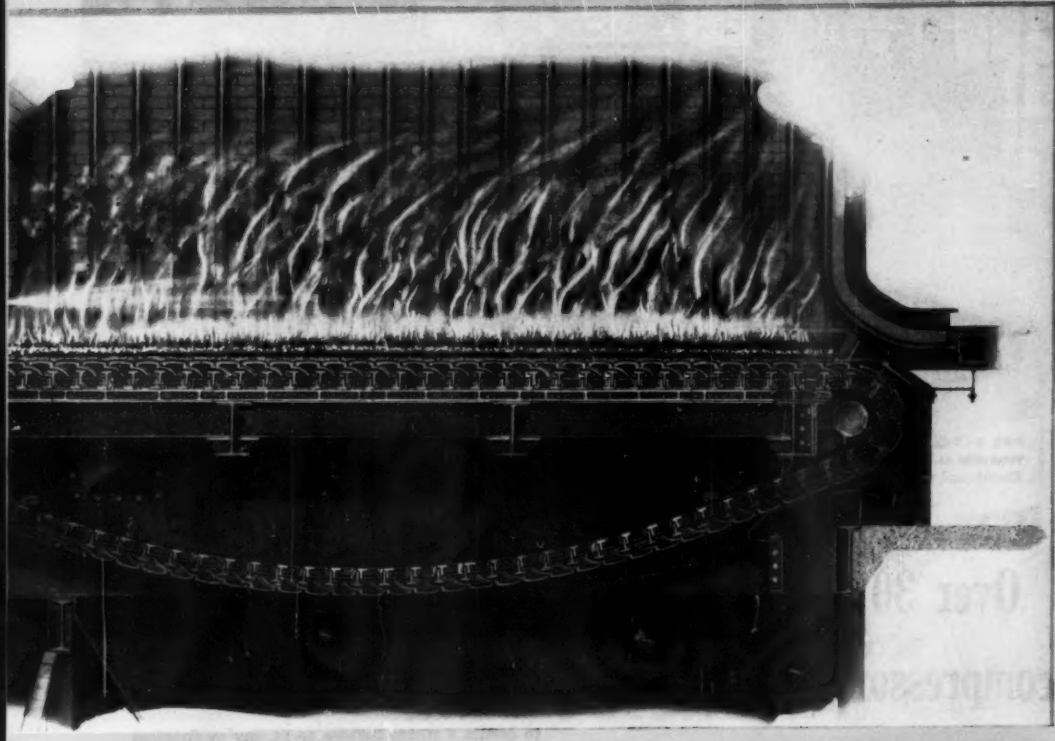
GRATE"

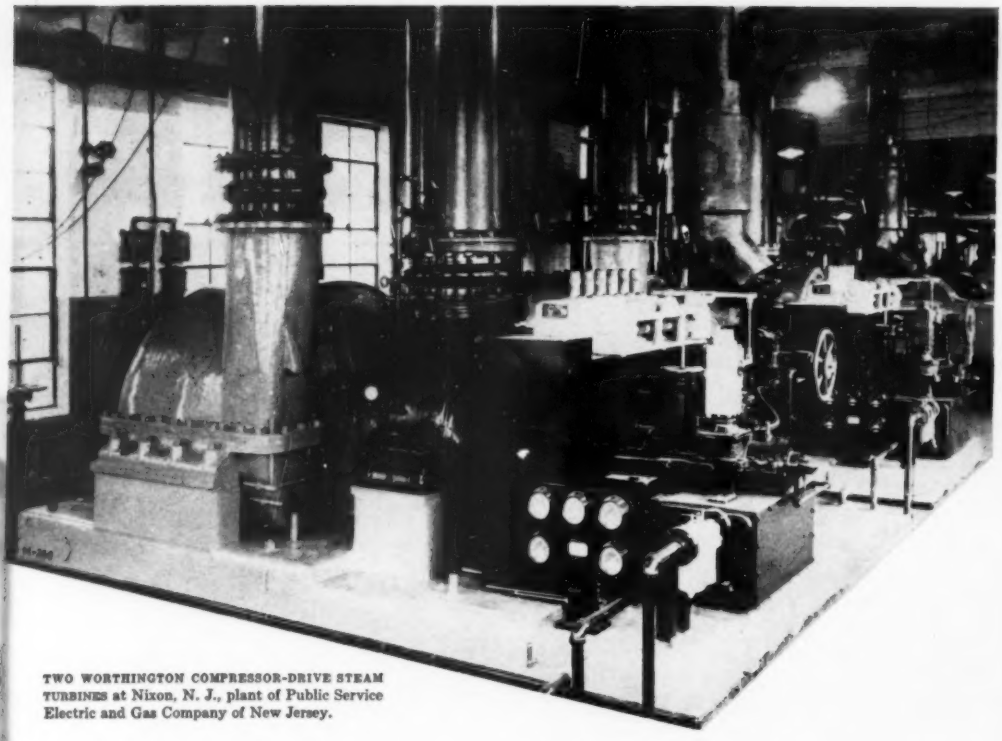
IN SPREADER STOKERS



Ruggedness is Built into the TRAVAGRATE

Removal of grate sections shows the husky drive shaft and heavy duty sleeve type bearings. All bearing lubrication is provided from a central location outside the stoker structure. TRAVAGRATE grate sections do not separate as they turn around the sprockets. Each grate section fits snugly but in such a manner that replacement can be made quickly.

Erie, Pa.



TWO WORTHINGTON COMPRESSOR-DRIVE STEAM TURBINES at Nixon, N. J., plant of Public Service Electric and Gas Company of New Jersey.

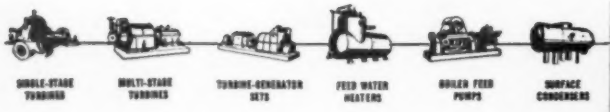
Over 30 Worthington compressor-drive turbines serve Public Service of New Jersey

In a business where "service" is always the first consideration, Public Service of New Jersey has picked a long-service performer—the Worthington Steam Turbine—over thirty times, for installations from Jersey City to Trenton.

Public Service of N. J., like many other Worthington users, know that the biggest secret behind the Worthington turbines' service reliability lies in *engineering*—Worthington's ability to design a steam turbine to fit any mechanical drive. And that engineering ability is backed by experience in thousands of installations of all types and sizes—*the broadest experience you can find in compressor-drive engineering.*

Worthington builds compressor-drive turbines—all types and sizes—up to 25,000 hp. A wide variety of governors fits them for all operating conditions. Write for bulletins to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.

T.1.6



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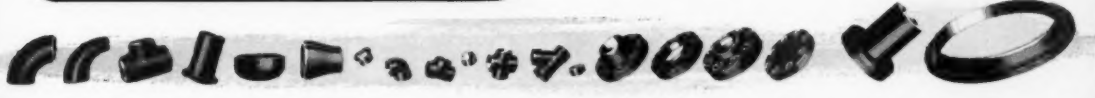
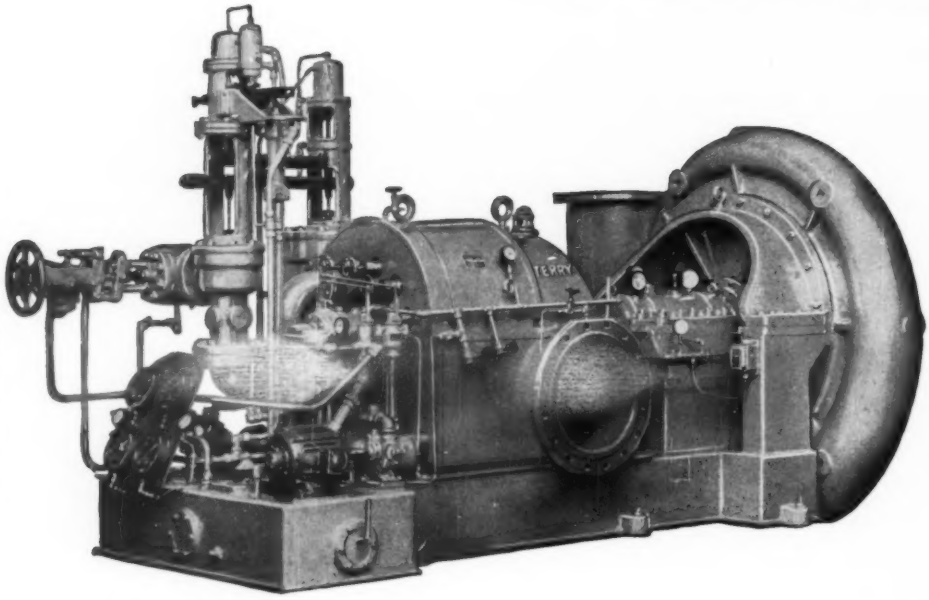


The TERRY TURBINE



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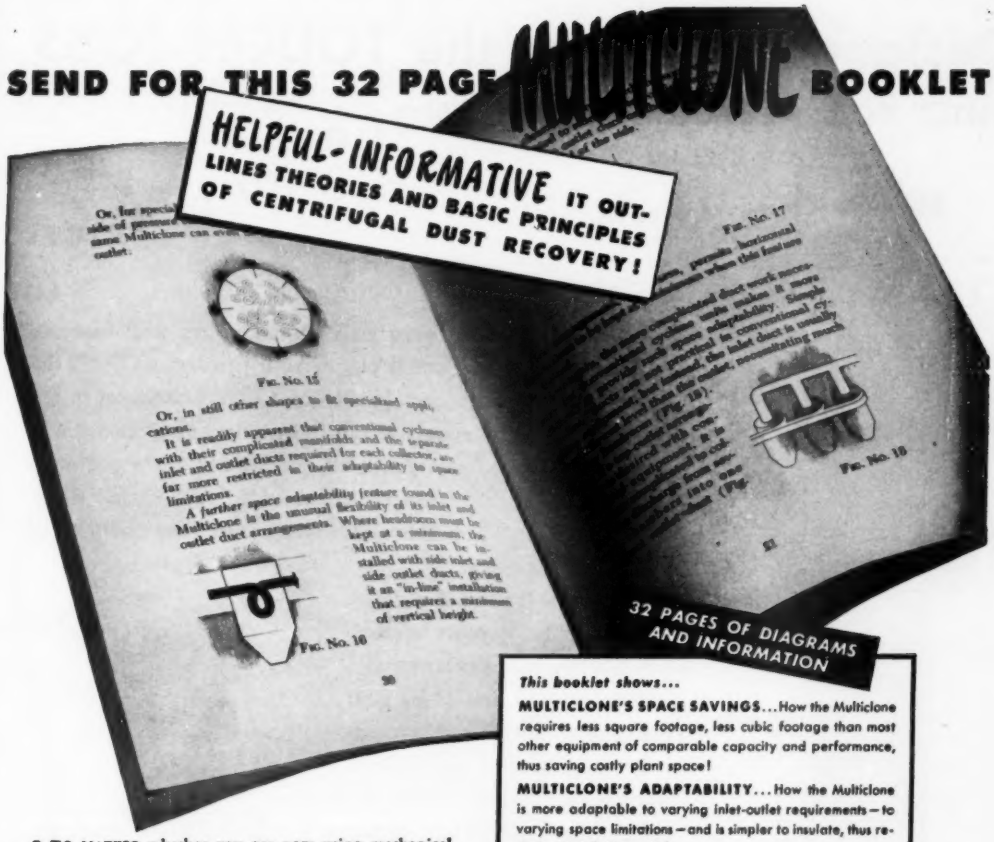
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Fig. No. 18
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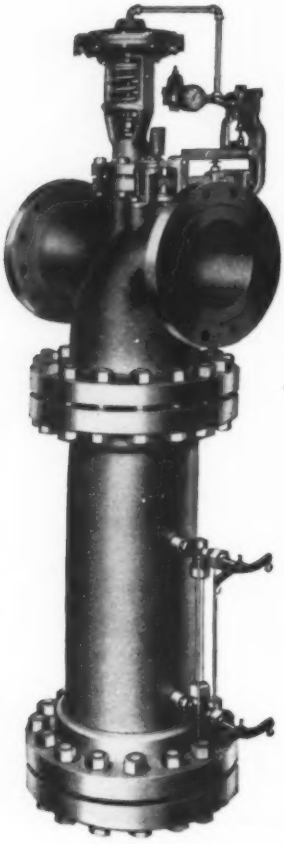

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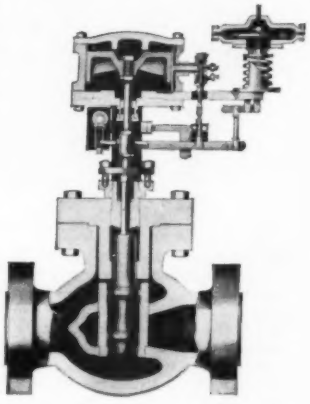

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Paper rejects were high due to poor sizing. Since water was blamed, Hall engineer made plant study, found that sizing procedure on one shift was not properly controlled. Situation was corrected and trouble stopped. Hall Engineer helped paper company find the trouble even though water wasn't responsible.

HALL

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Routine check of 18,000 lb. per hr. boiler by Hall Service Engineer showed proper water conditions. Hard deposit found under normal sludge in mud drum was a "stopper." Hall report suggested heat leakage against drum. A check showed that packing between bridge wall and drum was gone. The Hall Engineer *predicted* the trouble in this case.

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To speed up batch thermal processings of vegetable oils, plant engineers used extended-surface exchanger tubes. After repeated corrosion failures, Hall was consulted. Hall helped plant engineers effect design changes and set up chemical treatment. Processing units now stay in production.

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Its high lubricating value means more effective protection against wear under boundary conditions. Available in a wide range of viscosities.

Write today for complete information on Gulf Harmony Oil. Also ask for a copy of the booklet "Gulf Periodic Consultation Service," which tells about Gulf's advanced cooperative service for users of petroleum products. Gulf Oil Corporation · Gulf Refining Company, Gulf Building, Pittsburgh 30, Pennsylvania.

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Thus, by constant and accelerated testing, we quickly and definitely prove or disprove the claims that are made for many newly developed materials. And thereby we make sure that only the best goes into valves and fittings that bear the name Vogt.

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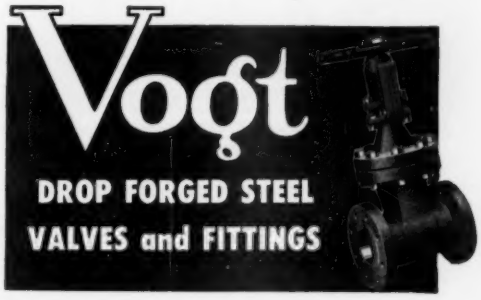
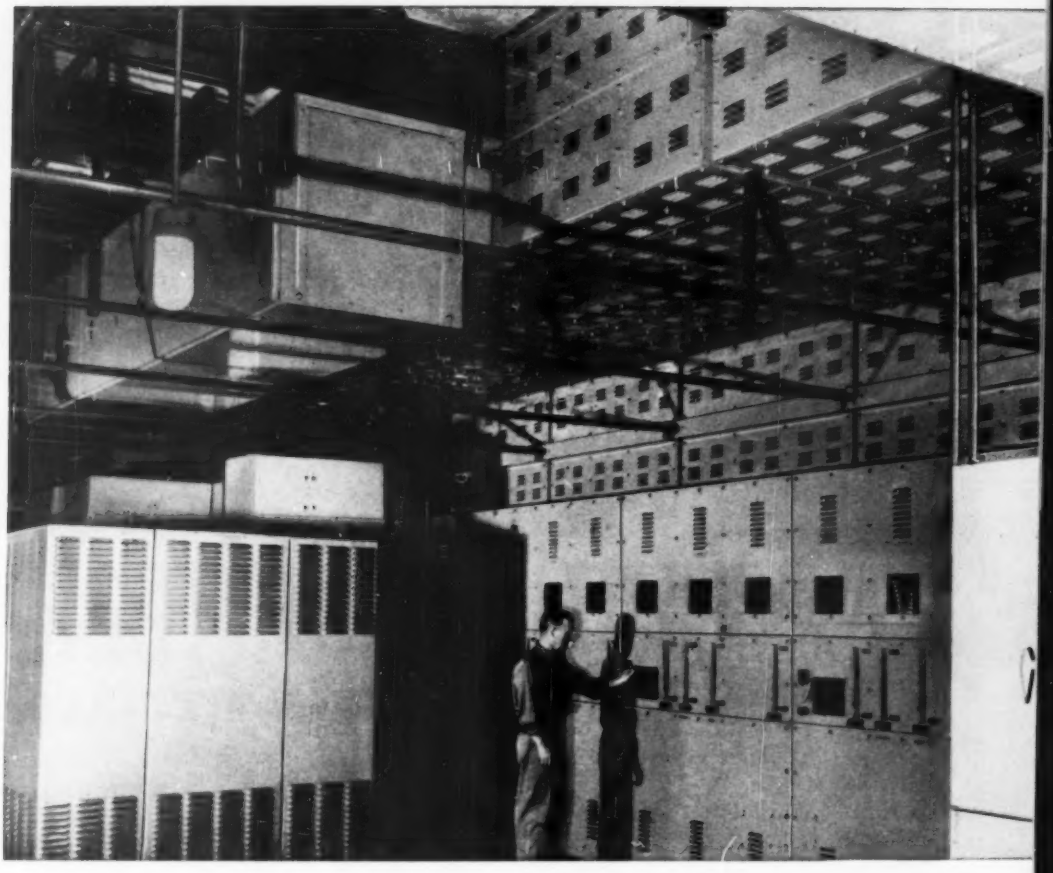


Switchgear for your entire station



COMPLETELY METAL-ENCLOSED COMPONENTS INSTALLED AS A UNIT. These units are part of over-all switchgear project. Attendant inspects cable entrance compartments. Note metal-enclosed bus overhead, potential transformers upper left, synchronizing reactors at lower left.

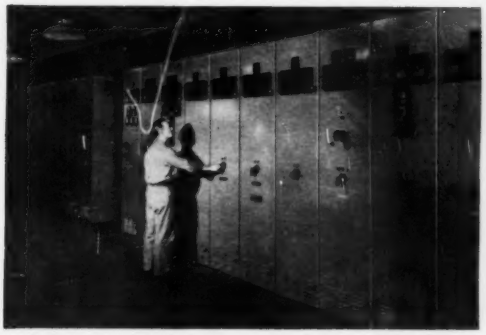
An outstanding example of

Project Planning

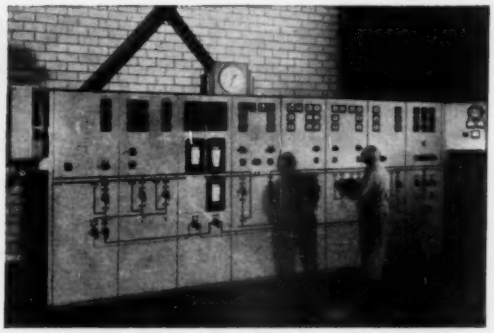
These General Electric, metal-enclosed equipments greatly simplify the planning of modern power stations. Installations may be made more compact. Complete enclosure in metal gives you greater safety and dependability.

Each of these metal-enclosed equipments is a completely co-ordinated unit—factory assembled and tested, shipped ready to install. Complete use of standardized G-E units permits an over-all co-ordination that may simplify your entire station design. For further information see your local G-E sales office or write to General Electric Company, Schenectady 5, New York.

ordered and installed as one unit

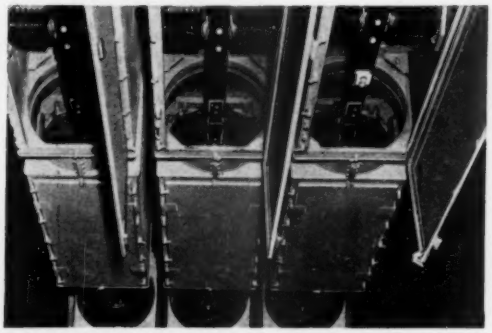


METAL-CLAD EQUIPMENTS with Magne-blast circuit breakers for medium capacity circuits. Factory-assembled and completely coordinated, they include circuit breakers, buses, interconnections and interlocks—all in one compact package.



METAL-ENCLOSED DUPLEX SWITCHGEAR for centralized control and metering. These complete, factory-assembled units have control and indicating equipment on the front panels and recording, regulating and protective equipment on the rear.

METAL-ENCLOSED CABLE ENTRANCE COMPARTMENTS for the local power feeders. They include cable potheads and group-operated disconnect and grounding switches which permit easy isolation of the cable during maintenance.



METAL-ENCLOSED ISOLATED-PHASE BUS for all primary connections. Designed to withstand heavy-duty, high-capacity short-circuit stresses they are completely assembled and ready to install with other components.

METAL-ENCLOSED AIR-BLAST-CIRCUIT-BREAKER CUBICLES for main power circuits. Features included phase-segregation, mechanical interlocks, and silver contact surfaces. Available also with low-oil-content circuit breakers.

METAL-ENCLOSED REACTOR EQUIPMENTS factory-assembled with ventilated, grounded steel compartments—all ready to interconnect with metal-enclosed bus. Hinged doors provide easy accessibility for inspection and maintenance.

GENERAL ELECTRIC

165-27

"Make-Up Oil Cut 19%"

— says Deltox Rug Co., Oshkosh, Wis.

SINCLAIR OILS

Fine, smartly-designed fibre rugs made by the Deltox Rug Company are favorites with budget-wise consumers from coast to coast. The Deltox plant, in Oshkosh, Wis., generates its power with an Ames 4 cyl. Uniflow Steam Engine, shown here.

At first, this engine was giving Deltox engineers trouble with sludging and oil emulsification in the circulating system. Then, about a year ago, Deltox changed to Sinclair RUBILENE® Oil Medium. The gauge glass was watched vigilantly, but there was no evidence of emulsification or developing sludge.

Besides ending emulsification and sludging, the subsequent yearly overhaul showed practically no valve cam or bearing wear; and carbon deposits in the valve gearing were negligible. Furthermore, a check of past records showed a cut of 19% in make-up oil.

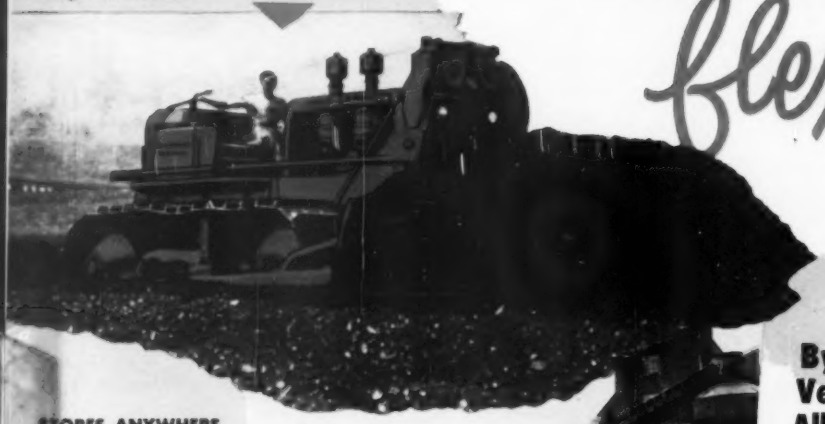
Are you get ing full satisfaction from the circulating systems in your plant? Perhaps a Sinclair Engineer can save you maintenance and operating expense. Get in touch with your nearest Sinclair Representative, or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

MAKING A CHECK. Sinclair Rubilene shows complete separation from water.

for circulating systems

MAKE COAL HANDLING *flexible*

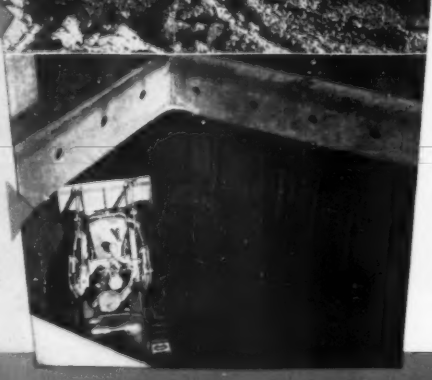
MOVES AND COMPACTS COAL — Allis-Chalmers torque converter tractor with Gar Wood dozer moves coal up to 750 ft. from crusher chute out over storage pile at Georgia Power Co. plant near Macon, Ga. The 41,000 lb. tractor compacts the coal to eliminate danger of combustion.



STORES ANYWHERE, RECLAIMS AS NEEDED — Handling coal with four A-C Tractors and Gar Wood scrapers permits placing storage piles wherever there is available space around the Miami Fort plant of The Cincinnati Gas & Electric Co. Coal is hauled up to 1700 ft., spread in thin layers and compacted. The self-loading scrapers efficiently haul coal as needed to reclaiming hopper.

STOCKPILES — HD-5G Tracto-Shovel stockpiles coal as it is unloaded from railroad cars at Crown Cork and Seal Co., Baltimore, Md. Also used to load into trucks.

HELPS UNLOAD — Canada Cement Co., Montreal, uses HD-5G Tracto-Shovel with dozer to pull coal and cement from sides and ends of ship hold into reach of crane bucket. Eliminates hand shoveling, speeds up unloading.



By Using Versatile Allis-Chalmers Tractors *you can*

- ✓ Handle *all* of your coal storing and reclaiming — or supplement existing facilities.
- ✓ Add storage areas anywhere without installing costly conveyors, tracks, etc. — or abandon them without leaving money tied up in idle equipment.
- ✓ Speed up handling during rush periods by adding more tractor units.
- ✓ Quickly change storage system or methods... crawler tractors work free of rails and runways, make their own "roadway" anywhere!

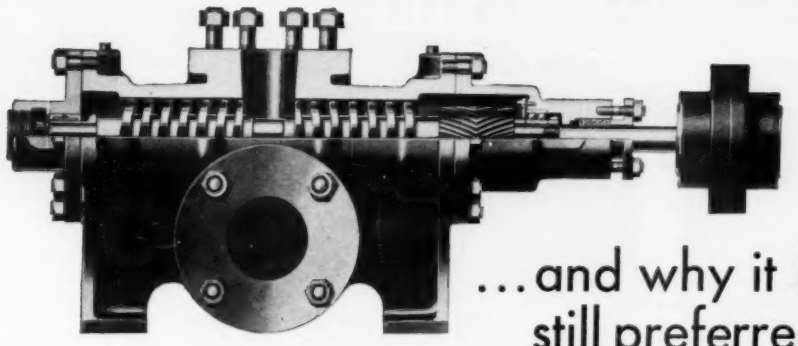
Send for free booklet, "Economic Coal Storage with Allis-Chalmers Tractors." Describes modern coal-handling methods, using A-C tractors and 'dozer blades, front-end loaders and scrapers. Write Allis-Chalmers Tractor Division.

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

QUIMBY

...the Original Screw Pump



...and why it is still preferred

100% Anti-friction bearing equipped. Due to their rolling action and minimum lubricating requirements, anti-friction bearings maintain their original clearances without appreciable wear. No hydraulic shock or discharge pressure loads on the bearings because Warren-Quimby Screw Pumps are 100% balanced axially.

Quadruple non-slip screws. A specially generated curvature is now used, producing a straight line contour between screws, essentially eliminating all slippage between these elements. Closer clearances without metallic contact insure higher efficiencies over longer periods.

Balanced power, pulseless discharge. No special foundations or bolting required for successful operation. Smooth running and quiet, with a minimum of churning or foaming of liquid handled.

No stuffing box troubles. In general, there are no packing troubles with Warren-Quimby Screw Pumps. By using sets of opposed intermeshing pumping screws, the flow of liquid is from each end toward the center, insuring suction pressure only on the stuffing boxes.

Herringbone Driving Gears. Smoother flow of power from the driving shaft to the idler shaft is accomplished by multi-tooth, precision cut, full herringbone gears. These gears are so positioned and timed as to maintain a definite clearance between the pumping screw elements.

Positioning Bearing. A fixed ball or roller bearing on the drive shaft effectively absorbs all external thrust loads. This permits full floating screw elements, free to expand at elevated temperatures without harm to the pump.

Interchangeability. All parts, excepting the body and length of screws and shafts, are interchangeable with corresponding sizes in the gear-in-head and external bearing designs.

The most complete line of Screw Pumps in the industry.

Insist upon the original...now owned, manufactured, marketed, serviced and guaranteed by Warren . . . one of America's pioneers of the pump industry. Write for bulletin S-204.

PG-1

WARREN QUIMBY PUMPS

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC., WARREN, MASSACHUSETTS

It's TOPS... so it's MARLEY!

GEAREDUCERS

designed specifically for cooling tower fans

Geareducers are designed and built by Marley to do just one job—drive fans up to 264 inches in diameter—and do it better than any other mechanism. Years of research and field service prove Geareducer design provides everything needed to resist thrust set up by huge fans. This includes oversize taper roller bearings; hardened alloy steel gears of scientifically selected ratio; pumpless, continuous splash lubrication, super-strong shafts and cases. Every detail of the design has a specific purpose: consider the wide-spread feet for great stability and the magnetic drain plug that retains any loose particles of metal that might cause wear.

In production all machine processes are constantly inspected with exacting care. When completed, every Geareducer is run in, disassembled, carefully checked part by part, completely coated with moisture resistant grease, and reassembled for shipment.

producers of
DOUBLE FLOW TOWERS
DRICOOLERS
AQUATOWERS
NATURAL DRAFT TOWERS
CONVENTIONAL TOWERS
SPRAY NOZZLES
VAIRFLO TOWERS
DOUBLE FLOW AQUATOWERS

MARLEY

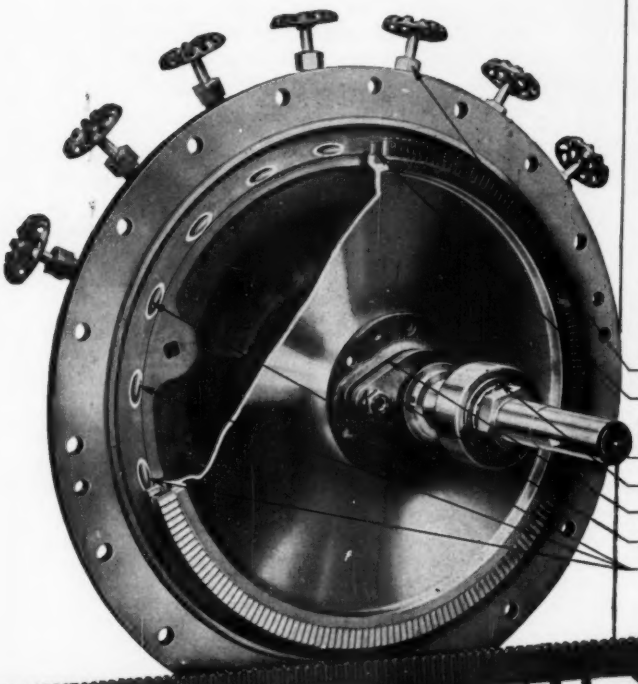
The Marley Company, Inc.

Kansas City 5, Missouri

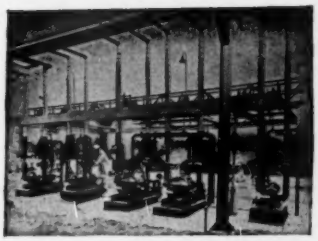
No other steam turbine offers you

SUCH VERSATILE STEAM NOZZLE CONTROL

The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



- 7 hand valves for efficient partial load operation, (20" turbine shown)
- 2 row velocity-stage turbine wheel with stainless steel turbine buckets — statically and dynamically balanced
- 30-40 carbon steel shaft
- Oversized double row deep grooved ball bearing
- Stuffing box with metallic packing ring
- Heavy chrome plating of shaft through stuffing box
- 3 nozzles always open



Coppus Steam Turbines, Type TF, driving chemical transfer pumps at Celanese Corporation of America's Chemcel Plant

Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes

MAKE TURBINE DOLLARS GO FARTHER

Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORP., 162 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

Utilize the flexibility of

...for continuous and uninterrupted

Check this Flexibility

- √ *Variety of bridge circuits... Wheatstone, Kelvin, Impedance, resistance thermometer, thermocouple, etc.*
- √ *Variety of auxiliary switches for audible or visual alarms.*
- √ *Variety of chart speeds—½" to 120" per hour.*
- √ *Variety of printing speeds—1 to 30 seconds.*

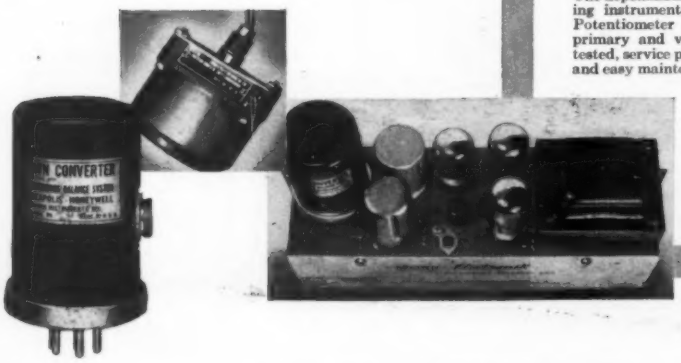
THE flexibility of the entire line of Brown instruments makes available a variety of combinations well qualified to meet the measuring, recording and signalling demands of any power plant. And the standardization and interchangeability of components simplify maintenance and stocking of parts.

Applicable to the measurement of temperature, pressure, flow, power, current, frequency, speed, pH and conductivity... such flexibility in measuring variables is easily obtained by changing the bridge circuit and primary sensing element.

Check the flexibility features... then call in our local engineering representative for a discussion of how they can add to your operating efficiency.

Dependability, Too!

The dependability you demand from your recording instruments is insured by the *ElectroniK* Potentiometer... by the dependability of its primary and vital components which are life-tested, service proven, and designed for minimum and easy maintenance. It takes little more than a glance to appreciate the ruggedness of the positive balancing motor, the hermetically-sealed converter, the simplified continuous balance amplifier... as well as the minimum of moving parts and the obvious freedom from adverse effect of dust and atmospheric moisture.



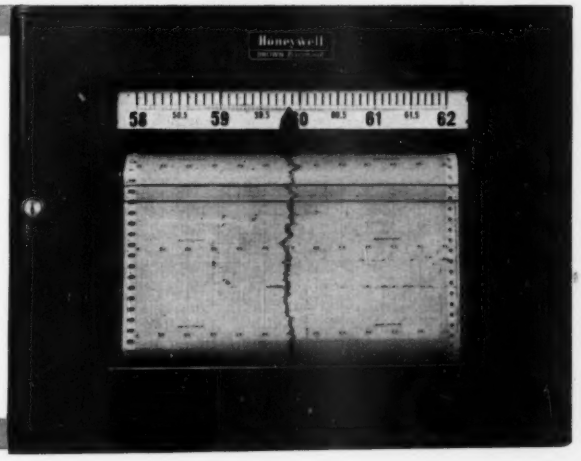
ElectroniK Potentiometers

frequency measurement...

THE *ElectroniK* FREQUENCY RECORDER

Important Features

- *Continuous Balance measuring system—with electronic non-cyclic balancing—not mechanical in operation.*
- *Frequency change as small as 0.01 cps initiates rebalancing action.*
- *Calibrated accuracy within 0.025 cps at normal frequency.*
- *Unit construction eliminates delicate mechanical linkages . . . assures long trouble-free operation with minimum of maintenance.*



THE *ElectroniK* Frequency Recorder is a *must* for central stations and systems offices. It provides an *uninterrupted* check on generator performance by its instantaneous measurement of frequency . . . furnishes accurate, permanent records . . . and makes load dispatching easier.

Operating on the electronic "continuous balance" principle, the recorder features unusual sensitivity and dependability. Its balancing motor and mechanism move only during a frequency change, thus reducing wear of parts to an absolute minimum. Its scale—12 inches wide—makes for easy readability at a distance, for checking the direction and amount of frequency deviation.

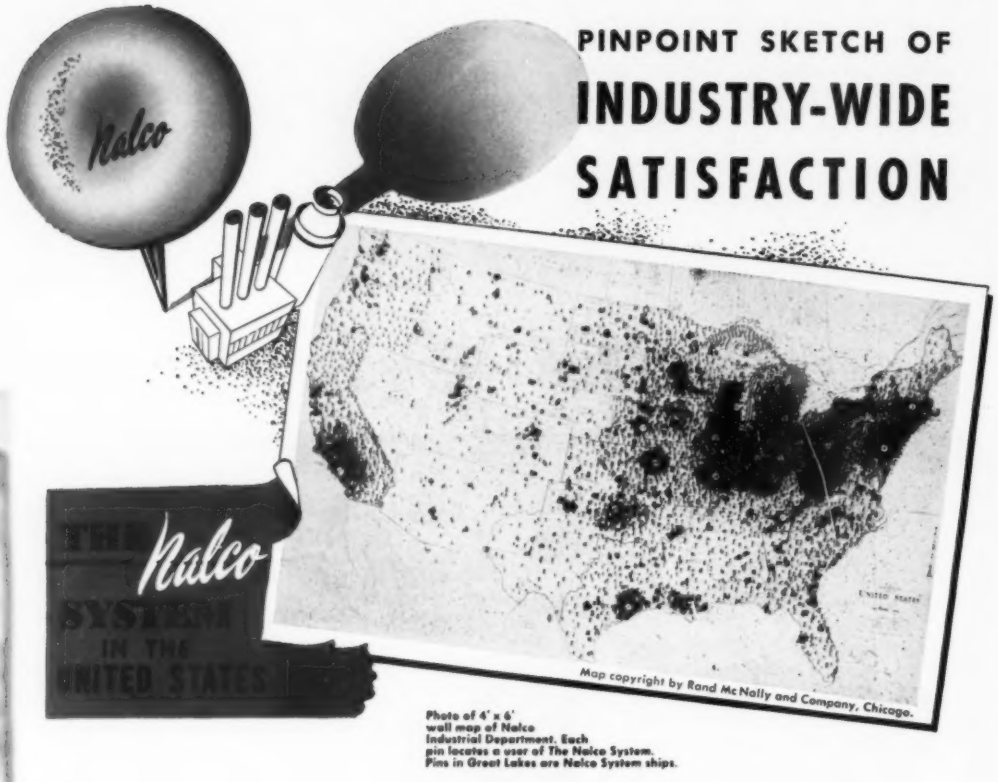
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4587 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS

First in Controls

● *Important Reference Data*

For more detailed information, write for Data Sheet No. 9.1-8 . . . and new Catalog No. 90-2, "Supervisory Instruments for Power Generation."



PINPOINT SKETCH OF INDUSTRY-WIDE SATISFACTION

Photo of 4' x 6' wall map of Nalco Industrial Department. Each pin locates a user of The Nalco System. Pins in Great Lakes are Nalco System ships.

NALCO System installations and ships*—each a pin in the map above—literally blanket the industrial and fresh water navigation areas of our country. The reason is simple: *satisfaction with Nalco chemicals and services.*

If you are not already getting the efficiency and economy of The Nalco System in your plant, now is the time to find out about it. Best Nalco Salesmen are Nalco Users—and there are sure to be several near you. For prompt Nalco Service, call or write today.

**This map does not show the thousands of miles of railroad lines and terminals served by Nalco . . . That requires another large map by itself!*

NALCO CHEMICALS AND SERVICES

- **WATER TREATMENT**—Chemicals and Consulting Services. Boiler feedwater, internal and external, locomotive and stationary. Cooling waters. Paper and pulp mill processing waters. Chemical and Food processing waters. Potable waters (slimicides and softening).
- **COMBUSTION CATALYSTS**—SR Series Chemicals for coal and oil fuels.
- **ANTIFOAM AND STABILIZATION** chemicals for water and other liquids in process.
- **LABORATORY RESEARCH**, commercial analyses, consulting services.
- **PAPER AND PULP MILL** pitch and clay control, size control, slime and mold prevention.

Additional information on any Nalco Chemicals and Services will be furnished without obligation.

NATIONAL ALUMINATE CORPORATION
6224 W. 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco SYSTEM...Serving Industry through Practical Applied Science

Helpful Bulletins

THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. List the paragraph numbers of those you want on the card below, detach and mail.

INSTRUMENTS AND CONTROLS

101 Electronic CO_2 Recorder — Introducing company's Condu-Therm CO_2 recorder, 12-pp Bulletin 51-1008 explains that this instrument combines use of CO_2 measurement as a guide to combustion efficiency, the thermal conductivity principle of gas analysis, and electronic operation. Illustrates both analyzing and recording sections, explains their functions, also discusses gas sampling systems. The Hays Corp.

102 Measuring, Testing Equipment — Eighty-pp Catalog GEC-1016 summarizes for the first time under one cover all of company's testing and measuring equipment for laboratory and production line use. To be used primarily as a reference to the apparatus available for the complex measurements to be made in industry, this catalog contains more than 150 photos and diagrams and describes the uses, features, specifications and prices of more than 120 devices, and also contains publication references to bulletins describing each one in more detail. General Electric Co.

103 Strip Chart Recorders — Specification Sheet 760 is on company's Tel-O-Set and miniature strip chart recorders designed for graphic panel use but applicable wherever miniature recorders are desirable. Pictures the recorders, describes method of operation. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

104 Self-Operated Controllers — Bulletin 1320 describes controllers designed for accurate temperature and pressure application, giving operating ranges, specifications and brief explanation of how the instruments work. Tagliabue Instruments Div., Weston Electrical Instrument Corp.

105 Water Alarm — A new Hi-Lo water alarm based on same thermostatic principle as the Copes feed water regulator is illustrated and described in Bulletin 493. This alarm is designed primarily for high-pressure service and is described as dependable at all working steam pressures. Standard signals are horn, lights. Operating principle explained, specifications given. Northern Equipment Div., Continental Foundry & Machine Co.

106 Low Resistance Ohmmeter — Bulletin 34-46 describes newest addition of company's Megger instruments, a general purpose low-resistance ohmmeter with two ranges: 0 to 1000 and 0 to 10,000 microhms. Includes photos of both battery-operated and rectifier-operated models, also schematic diagrams of electrical connections. Provides operating instructions, specifications. James G. Biddle Co.

ELECTRICAL

108 Totally Enclosed Motors — Construction details of manufacturer's Type AP3 totally-enclosed, fan-cooled motor are described in 6-pp Bulletin 51B7225. Stresses new cooling system incorporated for easier maintenance, long service life and low operating costs of these motors, suitable for use where there is dust, fly ash, rain, corrosive gases. Allis-Chalmers Mfg. Co.

109 Heavy-Duty Motors — This 8-pp newly released catalog provides ratings, prices and other data on manufacturer's line of single-phase, and polyphase heavy-duty motors in open, drip-proof, splash-proof and enclosed types, sizes from 1/20 to 5 hp. Photos show several models. Triad Engineering Corp.

110 Across-the-Line Starters — In response to demand for more complete information on company's RAS and RAR multi-speed and reversing magnetic motor starters, this 8-pp folder gives full data. Provides dimensions, weights, ratings on the compact starters; illustrates, describes them. The Arrow-Hart & Hegeman Electric Co.

111 Transformer Operation, Maintenance — The proposed AIEE guide for the use of openly-ventilated dry-type transformers with Class B insulation is presented in illustrated Bulletin 61X7088B, 8 pp. Gives general recommendations on installation, inspection, storage, maintenance and operation. Includes distribution and power dry-type transformers in ratings above 50 kva and above 600 v, cooled by natural or forced draft. Allis-Chalmers Mfg. Co.

112 Automatic Bus Transfers — This folder provides a condensed article on points to remember in specifying automatic bus transfers to insure continuous power supply for plant distribution systems. Illustrated with diagrams for switchboard etc., covers normal voltage loss, low voltage trip, return of normal voltage, operation, source of control power. I-T-E Circuit Breaker Co.

113 Service Replacement Capacitors — Comprehensive Catalog 200C, 28 pp, supersedes company's former edition and includes several new capacitor types such as extremely small moulded plastic capacitors, self-healing metalized paper capacitors, miniature ceramic disc capacitors. Other features of catalog include extended regular lines to cover additional sizes, simplified indexing and listings, many illustrations. Cornell-Dubilier Electric Corp.

114 Cable and Connector Chart — This nine chart shows correct fitting to use for five different types of wire and cable. Prepared for busy engineers, this handy chart can be tacked on the wall or placed under desk glass to save time looking up sizes. The Thomas & Betts Co., Inc.

VALVES, PIPING ACCESSORIES

115 Swing Check Valve — Bulletin W-1 is an instruction folder on manufacturer's cushioned swing check valve, covering installation, operation and maintenance. Includes dimensions, specifications and list of materials for this valve which is intended for in the line on the pump discharge, or elsewhere in line to prevent back flow. Golden-Anderson Valve Specialty Co.

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116 Four-Way Valves — Comprehensive data on company's new Crescent line of four-way valves is presented in Bulletin 1046. These are pilot-operated, solenoid-controlled valves, and are designed for continuous fast cycling without overheating, for single and dual pressure operation on air, water or light oil from 0 to 150 psi. Includes information on operation of valves, specifications, dimensions, prices. Barksdale Valves.

117 Automatic Regulating Valves — Bulletin 700 provides a large cutaway illustration of a pilot-operated regulating valve along with detailed explanations of five design features. A panel is devoted to showing how the control function of company's regulators can be changed by using a different sensitive pilot. Spence Engineering Co., Inc.

118 Heat Insulation — This 8-pp booklet on the use of hydrous calcium silicate insulation is illustrated with graphs, tables and drawings showing the numerous ways in which this insulation is used in industrial and commercial projects for temperatures up to 1200 F. Lists wide selection of shapes and sizes available to insulate tubes and pipes from ½ to 72 in. dia and vessels from 72 in. to 60 ft, also flat surfaces. Booklet also gives data on physical characteristics, recommended thicknesses, efficiencies. Kaylo Div., Owens-Illinois Glass Co.

119 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, dimensions; pictures typical installations. Also discusses possible variations of this type of valve. The Chapman Valve Mfg. Co.

120 Steam Trap Selection — Twenty-pp Catalog 600 provides practical selection information on bucket type steam traps, float and thermostatic types, compressed air traps, air eliminators and strainers. Explains how basic design principle of company's Airxpel traps fulfills requirements of a good trap. Pictures and describes available models, along with ordering, application information. Includes capacity-orifice chart. Wright-Austin Co.

121 Data on Strainers — Several types of pipe line strainers for all purposes in sizes from ⅜ to 36 in., some of which embody new concepts of design and function for making continuous production processes possible, are described and illustrated in 16-pp Manual 951. Summarizing important developments, booklet carries information on factors to consider in selecting type and size of strainer for a specific application. J. A. Zurn Mfg. Co.

122 Diesel Exhaust Hose — Published to meet widely expanding conditions in the diesel industry, Bulletin CMH-124 describes flexible metal hose and tubing for diesel applications. Deals with company's diesel exhaust hose — corrugated types for higher pressure installations and convoluted types, essentially used where long lengths of flexible exhaust tubing are required. Also covers types for diesel air, oil and fuel lines. Chicago Metal Hose Div., Flexonics Corp.

123 Expansion Joint Design Guide — Illustrated Catalog CMH 127, 16 pp, describing all types of corrugated expansion joints, gives complete specification and installation data for company's Flexonics-type free-flexing joints for low pressure applications; controlled-flexing joints, for greater amounts of traverse, and Flexonifter joints for extremely high pressure applications. Also covered are dual, hinged, balanced, and bulkhead units. Flexonics Corp. (formerly Chicago Metal Hose Corp.).

PUMPS, PACKINGS

124 Rotary Pumps — Illustrated Bulletin W-455-B1 covers a new heavy-duty rotary pump. Shows six models of this positive displacement, sliding vane pump offering capacities from 25 to 1000 gpm, speeds from 850 to 210 rpm. Includes dimensions, nominal ratings. Worthington Pump and Machinery Corp.

125 Proportioning Pumps — A high pressure, low capacity reciprocating plunger pump for use where a controlled capacity of fluid is required is featured in this illustrated bulletin. Also describes a chemical feed packaged unit utilizing this pump. Specifications provided, as well as an application chart covering simplex and duplex models of the Berco pump. The Bird-Archer Co.

126 Pumps for Wet Pits — Bulletin W-317-B12 describes manufacturer's Freedo pumps for sump, sewage and drainage service. These are pumps with non-clogging sewage pump impellers, according to bulletin, and capable of handling solids and stringy material. Illustrated with cross-section drawing, graph of coverage for 60-cycle motor speeds; gives sizes, flange data. Worthington Pump and Machinery Corp.

127 Rubber Sheet Packings — Included in this 8-pp bulletin are illustrations and descriptions of pure gum floating stock, neoprene, red rubber, pure gum stock, black oil-resistant, cloth inserted and diaphragm sheet packings. Service recommendations provided for each type, also standard thicknesses, weights per square yard. Packing Div., Raybestos-Manhattan, Inc.

GENERATORS

128 New Style Generator — Bulletin 22 introduces a new design of heat exchanger having internal compensator for extreme variations in temperature and flow rates, and is thus intended to offer precision control of outlet temperature when heating liquids. Construction features and operation of the new hot water generator are explained and illustrated, with emphasis on action of the compensator. Provides installation diagram, specifications, data on determining size, water capacities. Aerco Corp.

129 Package Steam Generators — Introduced in 24-pp Catalog PG-51-2 is this manufacturer's new line of packaged steam generators at design pressures of 250, 525 and 825 psi, for gas or oil firing, with or without superheat. Explains and illustrates basic construction of the generators, gives dimensions, capacities. Discusses automatic electric and semi-automatic controls. Foster Wheeler Corp.

WELDING

130 Welding Electrode Chart — Here's a selector chart (Bulletin GEC-537B) listing proper electrodes to be used in

(Continued on page 190)

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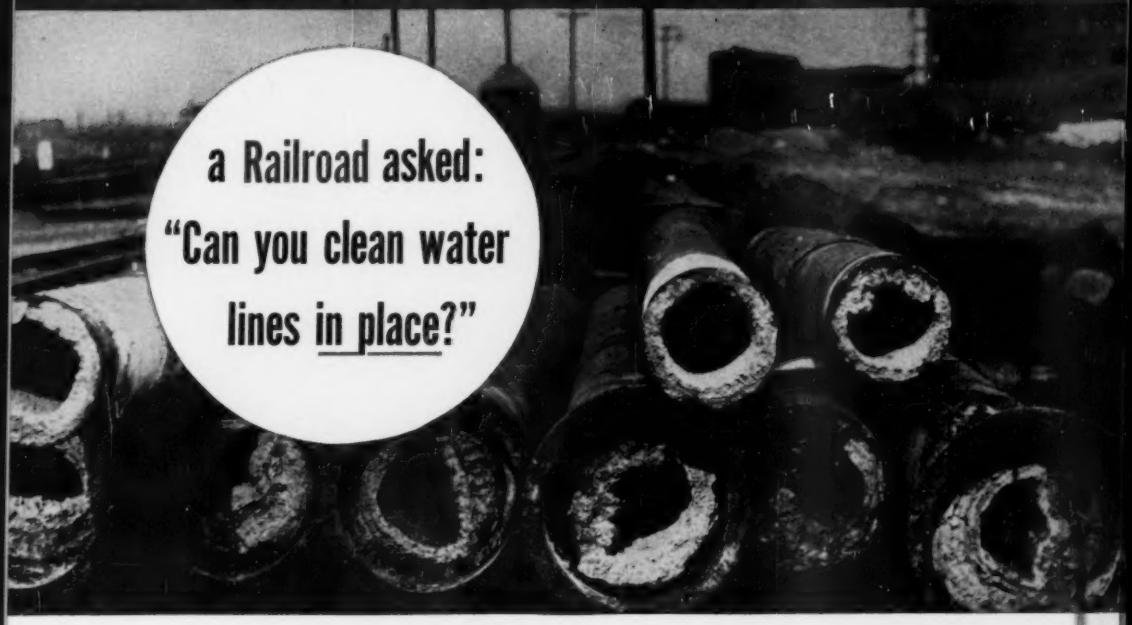
DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS



Dowell Service cleaned over 8600 feet of buried water line in six days!

You don't have to dig up water lines in order to clean them! Take the case of a major railroad that had over 8600 feet of *buried* water lines, ranging from 2 to 12 inches in diameter. The capacity of these lines had been greatly reduced by scale deposits. Dowell Service cleaned all the lines, *in place*, in only six days with a minimum interruption in service.

Dowell Service offers *fast*, effective cleaning of pipelines—underground or above, indoors or out. No digging or dismantling is necessary. Dowell liquid solvents, designed to dissolve the accumulated deposits, are introduced through regular connections. Because they are liquid, Dowell solvents reach wherever steam or water flow, cleaning places inaccessible to other methods—angles, curves, valves, complicated surfaces and hook-ups. *Experienced* Dowell engineers do the job, using Dowell-designed, truck-mounted pumps, mixers and control equipment.

Many other types of equipment can also be cleaned efficiently, economically by Dowell Service. If you have boilers, condensers, evaporators, bubble towers, water wells or other operating equipment where deposits are reducing capacity, let *Dowell Service save you time and money* in maintenance cleaning!

Other recent Dowell jobs:

Water well cleaned for large utility. Original production of 1150 gpm had dropped to 550 gpm. Dowell Service brought production back to 1100 gpm.

★

Boiler cleaned for steel company. Steam production before Dowell Service: 115,000 p.p.h.; steam production after Dowell Service: 145,000 p.p.h.

★

Air cooling system on two 22,500 K.W. generators cleaned for Midwestern Utility company in four hours. Before Dowell Service, the operating temperature of the generator was at the maximum allowable of 60° C. After service, the temperature was a normal 50° C.

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

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New York 20	Pittsburgh 19	Ft. Worth 2	Mt. Pleasant, Mich.
Boston 16	Detroit 2	Shreveport 69	Hamilton, Ohio
Philadelphia 2	Chicago 4	Atlanta	Charleston, W. Va.
Baltimore	St. Louis 8	Indianapolis	Salem, Illinois
Wilmington 99	Kansas City 8	Louisville	Beaumont, Texas
Richmond 19	Wichita 2	Upper Montclair, N. J.	Borger, Texas
Jacksonville 2	Oklahoma City 2	Anniston, Alabama	Midland, Texas
Buffalo 2	Houston 2	Hattiesburg, Miss.	Wichita Falls, Texas
Cleveland 13	New Orleans 12	Lafayette, La.	Hobbs, N. Mex.

★ *Maintenance cleaning service for industrial heat exchange equipment.*

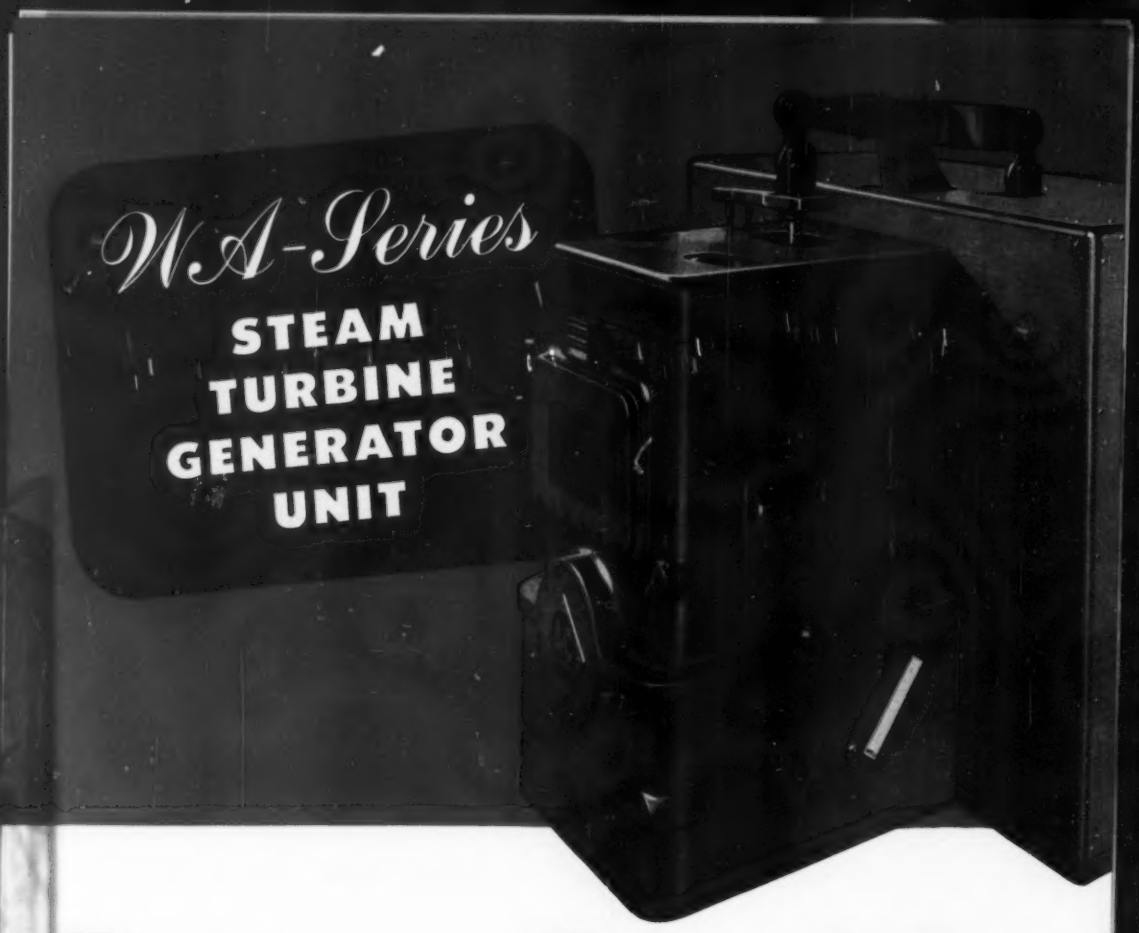
★ *Chemical services for oil, gas and water wells.*

★ *Magnesium anodes for corrosion control.*

DOWELL

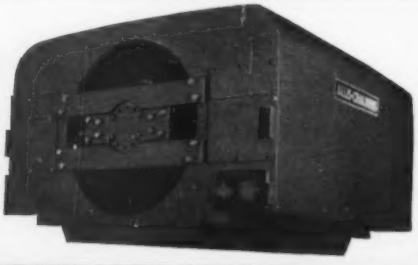
A Service Subsidiary of

THE DOW CHEMICAL COMPANY



Doing Double

AT ONE OF WORLD'S LARGEST MALT



SIMPLIFYING INSTALLATION, both turbine and generator (shown at left) are shipped as complete assemblies with the rotors locked in place. The WA-Series generator is of the housing type with air-coolers mounted in the stator above the floor lines, eliminating special coolers and duct work.

Ladish Malting Co. Uses Steam for both Processing and Power Generation

Duty

HOUSES!

GREAT QUANTITIES OF STEAM are required in the process of manufacturing 10 million bushels of malt annually at the Ladish Malting Co., Jefferson Junction, Wisconsin. And, as an economic by-product, the electric power needed for plant operation is generated by the same steam.

When this world's largest single unit malt house recently needed more generating capacity, Allis-Chalmers again was chosen. And with good reason, since two Allis-Chalmers units had been supplying the electric power consumed at the Ladish Malting Company for nearly fifteen years.

Installed in 1951, the modern 2500 kw WA-Series unit shown here is now on 24 hr a day, 7 day a week duty. It consists of a non-condensing impulse steam turbine and housing type air-cooled generator and exciter . . . carefully engineered and manufactured to operate as an integrated unit.

Built for condensing or non-condensing service in NEMA ratings through 7500 kw, a modern WA-Series unit also will enable *your* power plant to meet tomorrow's expanded power demand. Complete details contained in new Bulletin 03B7654. For your copy, just call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wis.

A-3601

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

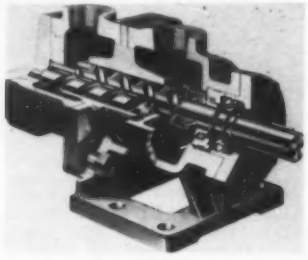
Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-paid card on pages 35 and 36 for your request. Just list the numbers of the items you'd like to know more about

1—OIL HANDLING PUMP

Is designed for applications involving pressures to 275 psi

The new IMO A313B pump is announced as affording savings up to 40 per cent in initial cost over company's other IMO models for similar pressures. A rotary positive displacement pump,



it offers all advantages of the IMO design, company states; it has only three moving parts, is quiet, pulsation-free, compact, excellent for high speed operation. It can be used for capacities to 80 gpm, pressures to 275 psi and intermittent pressures to 325 psi. It is intended for handling light or viscous fluids in hydraulic systems, rotary and steam atomizing oil burners, lubrication and governing systems. De Laval Steam Turbine Co.

2—MOTOR STARTER

With circuit breaker, has components mounted side-by-side

This combination starter, developed for use where side-by-side mounting is desired for reasons of space and arrangement, has the same self-indicating slam-proof handle as standard design with vertical mounting. The handle has separate positions for on, tripped, off, reset, and open cover; it will accommodate up to three different padlocks.

This starter is available in Sizes 0, 1 and 2 in sheet-steel enclosures for NEMA Types I, IA and V. Modifications such as built-in control circuit transformer and extra electrical interlocks can be supplied. Westinghouse Electrical Corp.

3—HEATING-COOLING UNITS

Shell and coil assembly; basic rating of 98 to 1760 Btu per hour

Designed for heating and cooling any combination of liquids and vapors, HX-Changers are suggested for such applications as water-cooled refrigerant condensers, converting air-cooled compressors to water-cooled service, combination water-cooled condenser-receiver; refrigerant to refrigeration heat exchangers on low temperature cascade and two-stage systems, water chiller using refrigeration as cooling medium, and for heating oils, chemicals, water and other liquids with steam.

These units incorporate a new sub-cooling feature designed to promote heat transfer efficiency. They're made with 6⅝ in. and 8⅝ in. shell; body is ASME welded construction. Coil tubes are copper, except when made for oil treating, in which case steel is furnished. All steel is recommended for ammonia refrigerant service. Rempe Co.

4—CEMENT COMPOUND

Is developed to set anchor bolts quickly, permanently, safely

Anchor bolts for permanently fastening machinery, hand rails or other equipment to concrete can be set quickly and with safety with Por-Rok Quick Setting Cement, according to manufacturer. Por-Rok is applied cold and simple to use — just drill the hole, set bolt in place, mix Por-Rok with water and pour it into the opening around the bolt. Within 15 to 30 min, the bolt is anchored. Por-Rok is described as self-bonding, self-levelling and non-shrinking. Compression strength is given as 4500 psi. The Hallemite Mfg. Co.

5—INDOOR METAL-CLAD SWITCHGEAR

Pre-engineered units for most common power apparatus and circuits

Ranging in ratings from 2400 to 13,800 v, 150 to 500 mva, this new standard line of switchgear offers several design improvements of significance, such as the magne-blast circuit breaker in which a maximum number of parts are interchangeable among breakers of different ratings. Solenoid mechanisms as well as other contact parts are identical in all ratings.

Another feature is an electro-mechanical-control device integral with the breaker mechanism. It is the heart of a control circuit system which is identical for all breakers operated from the same control voltage. Auxiliary switches for non-control functions are mounted on the stationary structure of the gear.

A new insulating material with excellent flame retardant, dielectric and anti-hygroscopic properties is used throughout the breaker, company reports, and its use serves to localize any damage occurring if abnormal conditions produce breakdowns. Recessed screened vertical openings are provided for top ventilation. Cable entrance facilities are interchangeable from top to bottom entry. Switchgear Dept., General Electric Co.

6—UNIVERSAL pH METER

For quick, accurate measurement of hydrogen-ion concentration

This new instrument is designed for all pH and rH work, for potentiometric titrations and for oxidation-reduction-potential investigations. Company announces that it provides a measuring accuracy of 0.01 pH or 0.5 mv, a range of 0 to 14.15 ph and 0 to 1415 mv, currentless measuring with no phenomena of polarization, zero indication by cathode ray tube; it can be used with glass, quinhydrone, hydrogen and platina electrodes and is direct calibrated for the first three.

The meter is supplied with a removable calomel and glass electrode and has controls to correct for temperature variations and for asymmetric potentials. It has a built-in cadmium standard cell and a flexible cable with a plug for connection to a 60 cycle a-c power supply circuit. Transformer taps can be changed to accommodate voltages of 110, 125, 145, 200, 220 and 245. The meter is enclosed in a wood cabinet weighing 46 lb. An auxiliary chemical assembly, also in a wood cabinet and weighing 11½ lb, is available as an optional accessory. Research & Control Instruments Div., North American Phillips Co., Inc.

7—SIGHT-FEED LUBRICATOR

For use with tube cleaners, other air- or steam-powered tools

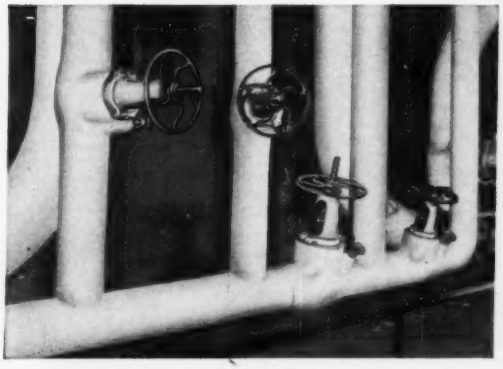
Once set, this automatic lubricator requires no adjustment, no turning on or

a better gate valve for 600-pound services ...CRANE pressure-seal bonnet design

Better—because these Crane valves completely eliminate bonnet joint maintenance. And because they assure power plants—industrial and utility—ideal flow conditions, with many added cost-reducing advantages.

For instance, they save on erection and suspension costs, because, size for size, Crane Pressure-Seal Bonnet Gates are much lighter in weight and more compact than flanged bonnet steel valves. Insulating Pressure-Seal valves takes less time and materials because of streamline contouring.

For complete information about Crane 600-Pound Pressure-Seal Bonnet Gates—also companion lines of 900 and 1500-Pound Gates, Globes, Angles, and Stop-Checks—send for Circular Ad-1819, or ask your Crane Representative for a copy.



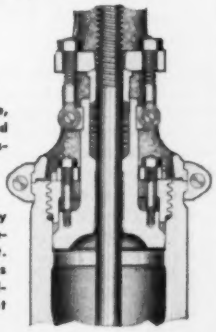
Boiler feedwater header in central station. No danger of bonnet-joint leakage; valves are Crane Pressure-Seal Bonnet Gates.

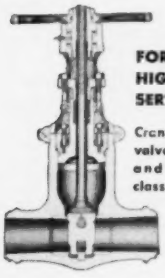
Patented and Patents Pending

600-Pound Butt Welding Gate for temperatures up to 1000° F. max.

NO BONNET-JOINT LEAKAGE OR MAINTENANCE

Bonnet joint is inside the valve, sealed with a wedge-shaped seal ring. Internal fluid pressure, acting upon the entire underside of bonnet, forces bonnet against seal ring and wedges it between the body and bonnet to form a pressure-tight metal-to-metal joint. Since pressure tightness does not depend on bolting, no periodic restressing of bonnet joint is needed.





FOR HIGH-PRESSURE HIGH-TEMPERATURE SERVICES

Crane Pressure-Seal Bonnet Gate valves are also available in 900 and 1500-Pound pressure classes.

CRANE CO.

General Offices:
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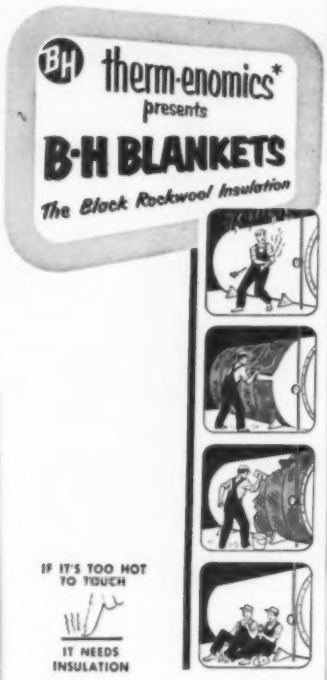
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING



Currently starring in the B-H review of insulating materials are B-H Blankets, felted between layers of any combination of: wire mesh and metal lath reinforcements to suit requirements. Some outstanding advantages of this versatile performer are:

- Effective to 1200°F
- 2' x 4' and 2' x 8' standard sizes
- Special sizes available
- Fast, easy, large-area application
- Fits curved surfaces
- Interlocking edges
- Incorporates lath for finishing cement
- High moisture resistance

Baldwin-Hill can help you cut down heat loss . . . by recommending a material and method of application, from its *complete* line of *Black* Rockwool insulations. For most efficient heat control at lowest cost — with blanket, block, cements, etc. — call in a THERM-ENOMICS® consultant.

Economics of Engineered Heat Control

Baldwin-Hill

8233

Clip this coupon and attach to your signed letterhead

SEND ME COMPLETE INFORMATION ON:

- ☐ Mono-Block—for temperatures to 1700°F
- ☐ Blankets—metal reinforced, large-area coverage to 1200°F
- ☐ No. 1 Cement—plastic insulation, to 1800°F
- ☐ Powerhouse Cement—high-adhesion finishing to 1700°F

Black Rockwool

BALDWIN-HILL CO., 902 BREUNIG AVE., TRENTON, N. J.

off, manufacturer explains; it is actuated by pressure of the operating air or steam, not by flow. As long as pressure is supplied, oil is metered into the operating hose. When operating pressure is off, oil flow is shut off. Oil is replenished by means of a filler plug which can be removed by hand.

The rate of oil flow is controlled by a knurled cap on top of the lubricator. This cap is backed off to increase flow, tightened to reduce it, depending on tool to be lubricated, flow is normally set for 25 to 50 drops per min, as observed in the sight glass. Once adjusted, oil flow is maintained at the proper rate. In tube cleaner service, adjustment is correct when a fine mist is seen at the motor exhaust.

Company points out that while this lubricator is suitable for many types of air- or steam-powered equipment, since its operation is based on pressure, a shut-off valve in the operating line must always precede the lubricator. It is therefore unsuited for use with tools controlled at the motor. Lubricator comes in pint- and quart-capacity sizes. Roto Div., Elliott Co.

8—MOTOR WATCHMAN

With built-in indicating light, mounted in NEMA Type 1 enclosure

In these NEMA Size 0 and 1 manual motor starters the indicating light generally is used to show whether the starter is on or off, but it can be wired into the circuit to indicate other conditions. The light can be provided for 110 to 600 v., a-c. Type I NEMA enclosure is furnished. Westinghouse Electric Corp.

9—RELIEF VALVE

To prevent excessive temperatures in hot water tanks, heaters

The No. 201 is a temperature relief valve of the automatic reseating type. Its operating heart is the Vernatherm thermostatic element, a hermetically sealed element containing a chemical mixture of organic and metallic particles which expand and contract in response to variations in temperature. Internal forces created by these temperature changes serve to open and close the valve orifice. The valve starts to open at 188F, reaches maximum capacity at 208 F.

Operating characteristics claimed for the Vernatherm element include high accuracy, durability and uniform expansion throughout operating range. It reseats itself automatically, closes off quickly at a few degrees below opening temperature to avoid hot water waste. This element is so located in the No. 201 that by adding a fixture connection to the valve, in addition to inlet and drain connections, the service flow can be made to pass around the element with every demand for hot water. This is said to assure more rapid and uniform transmission of temperature variations; reduce lag in temperature between water in tank and actuating part of valve; eliminate air pockets at the valve, and flush out valve mechanism constantly. The No. 201 is for operating pressures to 125 lb. Inlet, drain and flow connections are ¾ in. trappings. Shipping weight is 3 lbs. McDonnell & Miller, Inc.

10—LIMIT SWITCH

Rotating-type, for co-ordination of reversing operations

For application where reversing operation is to be coordinated with the number of revolutions of a motor shaft or driven equipment, this new limit switch supersedes four previous forms. It can be used to control travel limits on machinery, valves on machine tools, motor operated doors etc.

The switch consists of two of company's Size 2 Switchettes each having one normally open and one normally closed circuit. Switch units are operated independently by cams rotated through a worm and gear reduction from a shaft extending outside the case. Company says switch can be adjusted to operate 4 to 110 turns of the driving shaft with 5 turns over-travel in either direction. Control Dept., General Electric Co.

11—STEEL BLOWERS

Offer larger capacities and lighter weight; in three styles

Standard models in this new line of fabricated steel blowers range up to 200 hp. Three styles are available: the Model SG (multi-stage) and the SM (single-stage) operating at 3500 rpm; and the ST operating at 1750 rpm. Standard outlet pipe sizes are from 4 to 24 in., all flange fitted. The smaller models (through 10 hp) are described as particularly useful for mezzanine or elevated mounting in either vertical or horizontal positions.

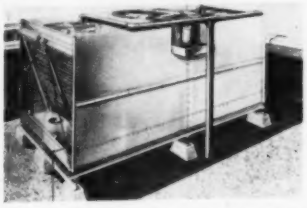
Designed on a standard basis for air only, they can be adapted to the use of corrosive, poisonous or explosive gases on special orders.

Blower outlets may be oriented in any of fourteen positions. Delivered air pressures up to 3 psi (5.3 in. mercury) may be had. As with company's other blowers, constant pressure is maintained irrespective of air volume, but power consumption is directly proportionally to air volume. Thus, company points out, half-capacity usage means only half-cost operation, a factor of unusual significance in terms of power economy, especially in the large blower sizes. Billmyre Blower Div., Lamson Corp.

12—COOLING TOWER

For use wherever intermediate capacities of cold water are needed

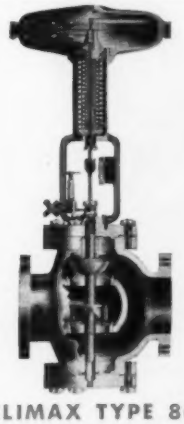
The Double-Flow Aquatower is announced as combining the efficiency of company's Double-Flow design with the compact simplicity of the Aquatower. It comes in seven standard sizes starting with a 50 t unit. Cooling towers in this range are widely used in the power,



petroleum, processing industries, and wherever air conditioning and refrigeration are used.

Outstanding features of the new tower are its low height (only 7½ ft for the 150-t unit), simplified design and maintenance, and even distribution of

76 BS&B CLIMAX CONTROLS CENTERS



CLIMAX TYPE 86

Diaphragm Control Valve. One of the most widely used controls in the Climax line.

Your Fastest, Most Efficient Service

In 29 states and 3 Canadian provinces 76 BS&B Climax Controls sales and service centers are prepared to meet your needs for fast, efficient, convenient service on automatic controls for regulating flow, levels, temperature, pressure and power. From these centers, including 43 strategically located warehouse stocks of Climax Controls and parts, Climax sales engineers are quickly available to render service on existing equipment or to help you plan new installations.

The widespread, closely integrated Climax organization is a definite assurance that your machinery and processes will function at maximum efficiency and with minimum interruptions when equipped with BS&B automatic Climax Controls.

Climax Controls catalog will be sent to you promptly at your request.

CLIMAX BS&B CONTROLS

BLACK, SIVALLS & BRYSON, INC.

Climax Controls Division Dept. 4-R2

7500 E. 12th Street — Kansas City, Missouri

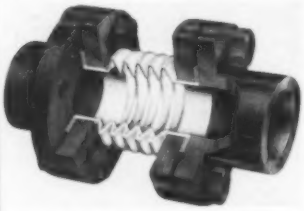
Climax Controls Factory: Tulsa, Oklahoma — Oil & Gas Equipment Div: Oklahoma City, Oklahoma

weight over a wider area than usual for cooling towers of similar capacity. Pumping head and required fan horsepower are low for any given capacity. This is said to be the first water cooling tower in the medium-capacity range to use the Double-Flow principle — one fan utilizing air from two completely open sides. The tower is available in all steel or wood with asbestos cement board casing. The Marley Co., Inc.

13—BELLOWS CONNECTOR

Made of Teflon, is intended for use on "tough" piping jobs

Fabricated of chemically inert Teflon, the new John Crane Bellows Type Connector is designed for pipe line applications where vibration, expansion, and electrolysis exist in the handling of corrosive liquids or gases and solvents. The new connector is said to be electrically non-conductive, flexible even at −94 F, and as strong at 480 F as at 70 F.



This bellows connector serves as vibration dampener as well as expansion joint, manufacturer states, and it connects misaligned couplings and insulates flanges electrically. End flanges of the joint are French-type envelope gaskets integral with the joint for easy assembly and tight seal. Crane Packing Co.

14—POWER PACKAGE

Hydraulic; is designed for either oil or water service

The Model S-440, a new, hydraulic power package, is announced as capable of output fluid pressures to 30,000 psi from 100 psi plant supplied air pressure. It is broadly applicable for uses where low volume output at high pressure is required, as in hydrostatic testing.

Requiring only two connections, one to plant air supply line and the other to manifold etc., from outlet fluid port of power unit for operation, this power package contains all necessary equipment, including air operated pump, air muffler, air filter, air lubricator, air regulator, valves and gages, all mounted on a masonite base. The unit measures 12 by 12 by 24 in.; weighs 45 lb.

Heart of the power package is company's Model 216-C pump. It uses either oil or water as testing medium, operates automatically on principle of differential areas. It is furnished in six standard models with ratios from 35:1 to 300-1, Sprague Engineering & Sales Corp.

15—SIGHT FLOW INDICATOR

For visual checking of flow of fluids in piping systems

Two windows are located on opposite sides of the Trin-Vue Sight Flow Indicator to permit maximum visibility. These windows are sealed in the unit by O-ring gaskets and Truarc retaining rings. Pressure on the glass in the unit is equally distributed at all times, company says, and there are no uneven stresses to cause glass failure or leakage under temperature changes.

Other features of the Trin-Vue are light weight, temperproof construction and a new type welded design. These indicators are made of heavy wall forged

tubing with Van Stone lap joint stub ends welded into the side of the body. The design of the Trin-Vue permits use of stock size tubing as well as steel flanges. A range of special materials is available, and sizes are from ½ to 4 in. Pyrex windows are standard; Herculite or quartz may be ordered. Trinity Equipment Corp.

16—MOTOR CONTROL UNITS

Are applicable to many outdoor motor control applications

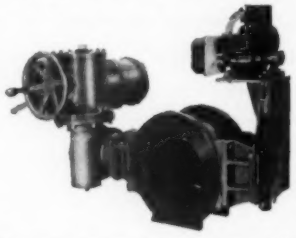
These units consists of a combination across-the-line starter with circuit breaker in a rain-tight enclosure, with a built-in start-stop pushbutton or hand-off-auto selector switch. The Bonderized sheet steel enclosure is finished in gray enamel and has a hinged cover which can be latched and padlocked. A neoprene gasket around the edge of the cover and protective shield at the top of the enclosure are provided to keep out rain. Pushbutton or selector switch and reset button are also rain tight, manufacturer adds.

A self-indicating handle for operation of circuit breaker has separate positions for on, tripped, off, reset, and open cover. Starter and breaker are mounted on a steel panel, permitting removal of complete interior as a unit for replacement or servicing. These starters are available in NEMA Sizes 1 through 5. Standard voltages are 220 and 440 v, 60 cycles; with proper coils starters are suitable for up to 600 v, company states. Westinghouse Electric Corp.

17—DUAL PURPOSE VALVE

Is "valve within a valve" for use in turbine bypass line

This 125-lb cast iron valve, the No. 818, consists of a 12 in. beveled vane which seats against the body side wall with a



4 in. vane mounted in the center of the larger vane. It is employed in a turbine bypass line for controlling the required quantity of water when the turbine is not in use or when it is operating at reduced capacity. Valve is equipped with 18-8 shafts, bronze bushings, and two lubricated stuffing boxes with two outboard bearings. Both vanes are motor operated.

Designed for either a high pressure drop and small volume or a low pressure drop and large volume, this type valve is frequently furnished with a small free revolving vane. It is available in various combinations of sizes and for elevated or sub-zero temperatures, either manual or automatic control. R-S Products Corp.

18—ANTI-RUST PAINT

Is developed for quick drying, good coverage of old metal surface

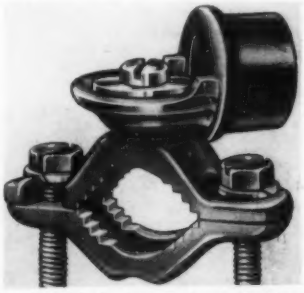
Rust Inhibitor No. FD-425, an improved formula of company's Certified Rust Inhibitor No. 425, is said to dry in 10 minutes under normal drying conditions. And, according to manufacturer, one coat of the new formula provides excellent hiding of the old metal surface. It is announced as withstanding temperatures from −100 F to 250 F, and as exceptionally resistant to salt air and fumes.

This new rust preventive paint may be applied over damp surfaces, interior or exterior, galvanized metal and new or rusted metal surfaces. It comes in several colors as well as aluminum and clear, gives a semi-gloss finish. United Laboratories, Inc.

19—GROUND FITTING

Rigid-type, solderless, for bonding ½ in. conduit to water pipe

The GF23 Ground Fitting is a rigid, extra heavy, high strength clamp of bronze alloy of high electrical conductivity. The fitting has a swivel conduit hub, adjustable to any position, which makes

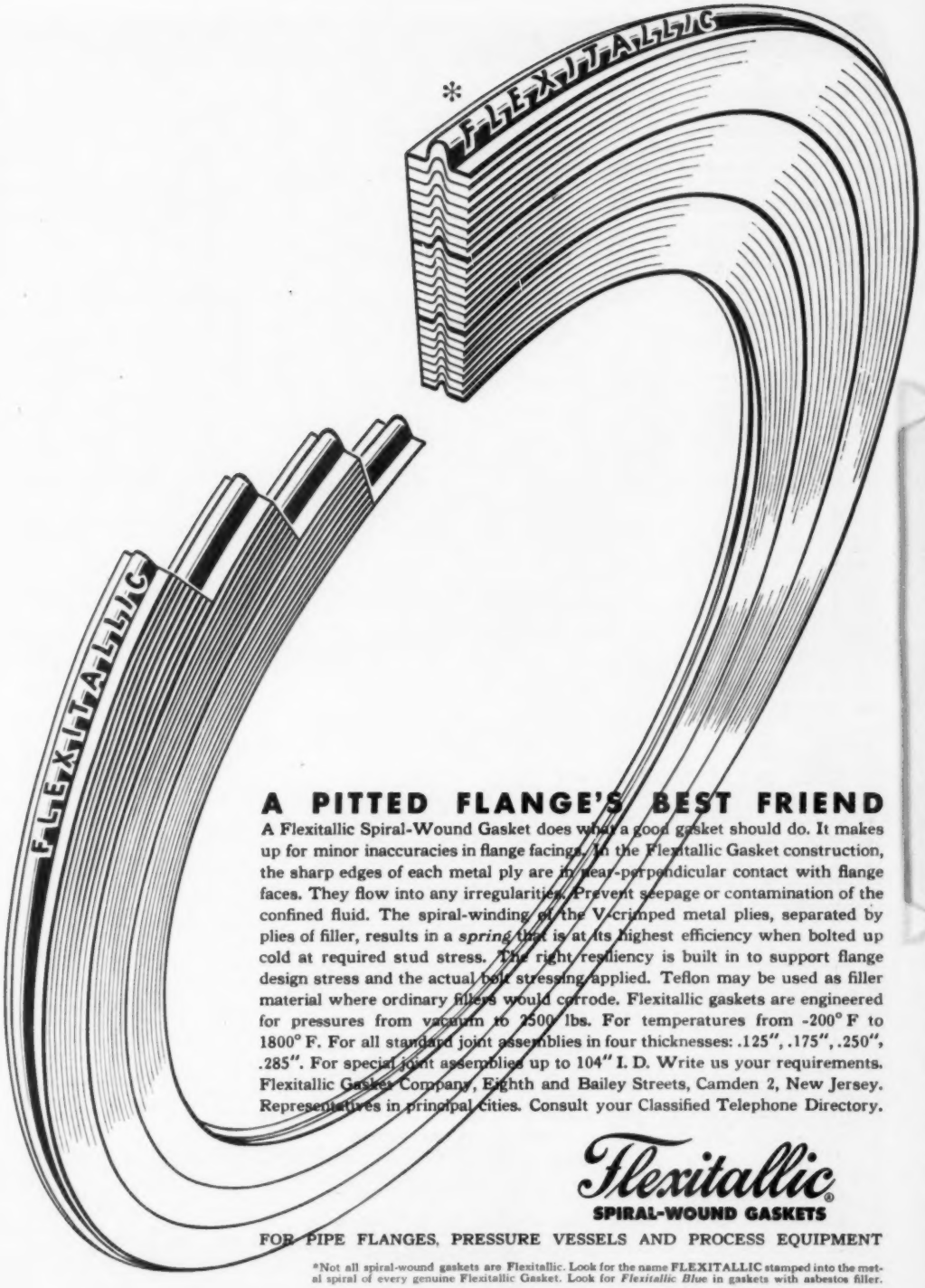


it adaptable for installation in hard-to-get-at locations. Manufacturer points out that the large clamping washer and design of the conduit fitting provide excellent protection for the wire connection. The new fitting accommodates up to No. 4 stranded AWG wire, ½ in. conduit, and fits ¼ to 1 in. water pipe as well as ½ to 1 in. dia ground rods. H. B. Sherman Mfg. Co.

20—TANG BREAK-OFF TOOLS

For removal of inserting tangs on helical-wire thread inserts

Operating on the principle of a spring-loaded center-punch, these tools are designed to remove tangs quickly without disturbing the inserts. Fourteen standard models permit tang removal operations at production rates on a wide range of sizes and lengths of company's stainless steel thread inserts. Heli-Coil Corp.



A PITTED FLANGE'S BEST FRIEND

A Flexitallic Spiral-Wound Gasket does what a good gasket should do. It makes up for minor inaccuracies in flange facings. In the Flexitallic Gasket construction, the sharp edges of each metal ply are in near-perpendicular contact with flange faces. They flow into any irregularities. Prevent seepage or contamination of the confined fluid. The spiral-winding of the V-crimped metal plies, separated by plies of filler, results in a *spring* that is at its highest efficiency when bolted up cold at required stud stress. The right resiliency is built in to support flange design stress and the actual bolt stressing applied. Teflon may be used as filler material where ordinary fillers would corrode. Flexitallic gaskets are engineered for pressures from vacuum to 2500 lbs. For temperatures from -200° F to 1800° F. For all standard joint assemblies in four thicknesses: .125", .175", .250", .285". For special joint assemblies up to 104" I. D. Write us your requirements. Flexitallic Gasket Company, Eighth and Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult your Classified Telephone Directory.

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FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* in gaskets with asbestos filler.

Catalog Library

THIS MONTHLY list of standard catalogs and bulletins is published to help power engineers maintain a permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the bulletins. Use the postage-paid card on pages 35 and 36 for your request

WATER CONDITIONING

201 Water Conditioning Information — Here are three informational bulletins. No. 28X7446 describes a simple way to determine total hardness in water, illustrating procedure. No. 28X7559 gives an analysis of the hot process-hot zeolite system, telling results to be expected. No. 28X7466 discusses current status of embrittlement in boilers, explaining causes and telling recent developments in control methods. List bulletins wanted. Allis-Chalmers Mfg. Co.

202 Modern pH and Chlorine Control — This 100-pp booklet gives details of company's color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; treating boiler feed water. W. A. Taylor & Co.

203 Water Softening Equipment — How problems caused by hard water can be offset by water softeners is explained in Bulletin 2386, 12 pp, describing ion exchange equipment. It covers in detail downflow, upflow and gravity zeolite water softeners. The Permutit Co.

205 Water Conditioning Bulletin — This is an 8-pp discussion of water and the chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition and application. Wright Chemical Corp.

206 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blowdown adjustment, test control. Describes available equipment and includes reference bibliography of literature on specific formulations. Dearborn Chemical Co.

207 Boiler Corrosion — A 12-pp article discussing cause and prevention of corrosion in boiler systems is presented in Betz Technical Paper No. 111. The corrosive effects of oxygen, carbon dioxide, ammonia, hydrogen sulfide, acidity, physical factors are evaluated. W. H. & L. D. Betz.

208 Chemical Treatment of Water — Bulletins describing various methods of chemical water treatment, including company's Coravol process, are available. Coravol is part of a complete technical service which provides special chemical formulas for boiler feed water, foam prevention, hot water supply, refrigerating brine, cooling and condenser water. Western Chemical Co.

209 Zeolite Water Softeners — Publication 4530, 16 pp, presents hydrogen zeolite (cation exchange) water softening equipment. Gives complete description of the process and the field of application, showing advantage of hydrogen zeolite softening and its relation to sodium zeolite softening process. Cochrane Corp.

210 Slurry Type Softener — Six-pp Bulletin W-212-B6 describes a slurry type precipitating softener and coagulator in which energy for floc preparation is mechanical, explaining and illustrating flow circuit. Question-and-answer appraisal of system. Worthington Pump and Machinery Corp.

211 What's New on Ion Exchangers — Here are three booklets covering company's ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

FUEL OILS, LUBRICANTS

214 Fuel Oil Treatment — By text and sketches, this folder points out undesirable conditions in the storing, pumping, heating and burning of industrial fuel oil and correction of these conditions by company's treatment. E. F. Drew & Co., Inc.

215 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, safety precautions. Cities Service Oil Co.

216 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is explained. Other chapters cover injection systems, combustion chambers, also lubricating systems, and diesel oil purification and filtration. Includes discussion of fuel and lubricating. Sinclair Refining Co.

217 Viscosity of Fluids — The larger significance of viscosity is discussed in Nos. 5 and 6, Vol. 36 of Lubrication, a technical publication. In six parts, the first illustrates simplest conception of streamline flow between two surfaces having relative motion. A series of torsion viscometers shows how viscosity acts and may be measured. Part II covers streamline flow in capillary and other small tubes. Part III covers turbulent flow in pipes. Part IV discusses effects of temperature and pressure on viscosity, and Part V includes viscosity index. Part VI gives brief reference to nature of plastic flow. The Texas Co.

218 Clean Oil for Diesels — A combination purifying and filtering unit utilizing centrifugal force and controlled filtration is the subject of illustrated Bulletin DL-1. Explains operation of the unit, tells advantages. Discusses importance of clean, dry lubricants, shows a schematic arrangement of piping for use of the Puri-Filter in removing dirt, carbon and water from lubricating oil. Also discusses purification of fuel oil for diesel engines. The DeLaval Separator Co.

VALVES, TRAPS, PIPING

220 Popular Steel Valves — Condensed Catalog 104, 28 pp, describes and illustrates most widely used of company's cast and forged steel valves and the data presented for these valves is complete. Those listed are chiefly in the basic steam pressure classes — 150 to 2500 lb — and include globe and angle, gage, instrument, hydraulic and relief types, also strainers, and check, gate, non-return and blow-off valves. Explains design features. Edward Valves, Inc.

221 Valves, Fittings and Flanges — Catalog F-9 is a 400-pp, permanently bound reference book on drop forged steel valves, fittings and flanges for practically all piping needs at high and low pressures and temperatures. Provides ordering information on company's complete line, also much helpful engineering and application data; includes a section on products for refrigeration service. Fully illustrated, indexed. Available to qualified power engineers, please give your title. Henry Vogt Machine Co.

222 High Pressure Gate Valve — Described in 4-pp Form DH-273 is a forged steel gate valve designed for long service and low cost maintenance. Working pressures, sizes and prices listed. R-P & C Valve Div., American Chain & Cable Co., Inc.

223 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

224 Steam, Air and Gasoline Traps — Illustrated Catalog 751, 32 pp, provides capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb; expansion steam traps for pressures to 250 lb; weight-operated traps for steam, air, gasoline, pressures to 1500 lb; piston-operated steam traps for pressures to 650 lb. W. H. Nicholson & Co.

225 Valve Specialties — Included in 90-pp Catalog A-50 is complete ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves, pilot valves; back pressure, relief and non-return valves, steam trap and air vent; liquid level controllers; solenoid valves. Includes capacity charts. Davis Regulator Co.

226 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Includes dimensions, weights; prices. Everlasting Valve Co.

227 Forged Steel Valves — Form 800-A describes 600-lb forged steel valves for high line pressure and temperature applications. Covers both inside screw and OS&Y union bonnet gate types, giving sizes, prices. The Ohio Injector Co.

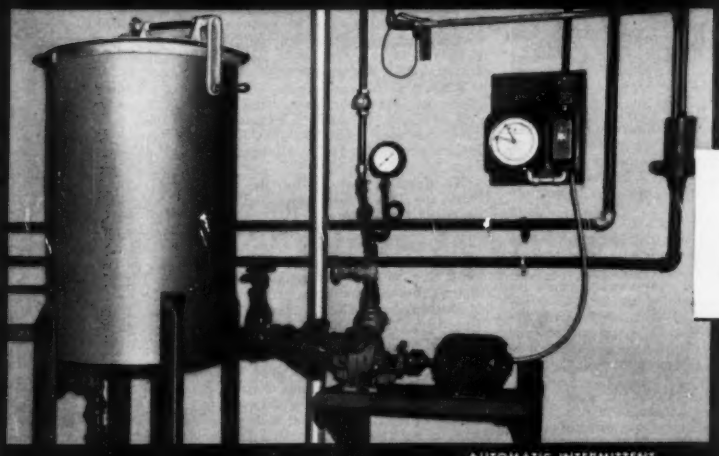
228 Trap Data — Here's a 12-pp condensed catalog giving information and prices on steam and air traps. Lists cast semi-steel and forged steel inverted bucket traps, compound steam traps, ball float air traps, Y-type strainers and internal check valves. Provides data on calculation of condensate loads and a selection of traps to handle these loads, also a full-page capacity chart. Armstrong Machine Works.

229 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure traps sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Also provided are installation and operating suggestions, prices. Yarnall-Waring Co.

230 Safety Head Catalog — Section 10, Part I of Catalog 54, 52 pp, is written in non-technical language and fully illustrated with cutaways and installation photos, charts and tables covering almost any phase of safety head information desirable. Tells where safety heads can be used and how to use them. Tells how to choose safety head assemblies and rupture discs. Includes tips for lowering temperature at point of safety head location. Black, Sivalls & Bryson, Inc.

231 Design Properties of Pipe — This 12-pp booklet consists of tables list-

(Continued on page 124)



AUTOMATIC INTERMITTENT FEEDING

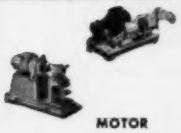
Dearborn has the

ENGINEERED EQUIPMENT

for your water treatment

BY-PASS FEEDERS

MECHANICAL CHEMICAL PUMPS



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AUTOMATIC CYCLE CONTROL

WATER TESTING CABINETS

FLO-CONTROL VALVES —TIMERS

To get the most from your water treatment, it's essential that the entire system be engineered for maximum efficiency.

Here Dearborn will help by analyzing your existing equipment and physical layout. With this information, a Dearborn engineer will then recommend the necessary equipment, whether it is to include a pump or timer—a test cabinet—or an automatically controlled feeding system.

Why not plan to discuss your water treatment and other boiler room problems with your Dearborn engineer? He will bring you all the benefits of Dearborn's broad experience in this field since 1887.

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POWER PLANT *Construction News*

Hope, Ark. — City Council has authorized plans for new municipal power plant to cost approximately $3,000,000, with turbine-generator, high-pressure boiler and auxiliary equipment. Proposed to carry out project in 1952. Burns & McDonnell Engineering Co., 95th. and Troost Sts., Kansas City, Mo., is consulting engineer.

Newark, Calif. — Lavino Refractories Co., 1528 Walnut St., Philadelphia, Pa., plans boiler house at new plant for manufacture of refractory brick and shapes at Newark, where large tract of land has been secured. Construction will proceed at once. It will comprise a number of buildings and will represent an investment of about $2,500,000. Completion is scheduled late in 1952.

San Leandro, Calif. — General Paint Corp., 2627 Army St., San Francisco, Calif., plans boiler house at new paint and varnish manufacturing plant at San Leandro. Entire project is reported to cost about $900,000. Skidmore, Owings & Merrill, 1 Montgomery St., San Francisco, are architects.

Santa Clara, Calif. — Keasbey & Mattison Co., Ambler, Pa., asbestos products, plans boiler house at proposed new branch plant at Santa Clara, where site was acquired a number of months ago. It will comprise several production units and is estimated to cost about $2,500,000. Work is expected to begin early in 1952.

Columbine, Colo. — Columbine Development Co., Grand Junction, Colo., plans power plant at proposed new bleached sulphite pulp mill at Columbine, near New Castle, Colo., where site was acquired a number of months ago. Project will comprise several production units and is reported to cost over $15,000,000. Work will be carried out in 1952. Ebasco Services, Inc., 2 Rector St., New York, N. Y., is consulting engineer.

Centerville, Iowa — Iowa Southern Utilities Co., Centerville, has arranged a construction budget for 36 mos., concluding in 1953, totaling about $17,000,000. Of this amount, approximately $8,750,000 will be used for new steam-electric generating station at Eddyville, Iowa, on which work has begun, previously noted in these columns, with completion scheduled early in 1953. It will be equipped for a rated capacity of 44,300-kw. Other work will include power substations, transmission lines, distribution system extensions and other operating facilities. Pioneer Service & Engineering Co., 231 South LaSalle St., Chicago, Ill., is engineer for power plant.

Great Bend, Kan. — Western Light & Telephone Co., Huron Bldg., Kansas City, Kan. plans new steam-electric generating plant at Great Bend. Details of equipment installation will be determined soon. Cost estimated about $3,000,000.

Louisville, Ky. — Stauffer Chemical Co., Inc., 420 Lexington Ave., New York, N. Y., plans steam-generating plant at proposed new factory near Louisville, for manufacture of carbon tetrachloride and other chemicals. Cost reported about $2,000,000. Work will begin soon.

Jonesville, La. — City Council plans extensions and improvements in municipal oil engine-operated electric power plant, with installation of equipment for increased capacity. Bond issue of $175,000, is being arranged for this and improvements in municipal water system.

Sykesville, Md. — State Dept. of Public Improvements, 506 Park Ave., Baltimore, Md., has approved plans for extensions and improvements in Springfield State Hospital, Sykesville, with installation of equipment for increased capacity. Cost reported over $575,000. Work is scheduled to be carried out soon.

Canton, Mass. — Department of Public Welfare, Commonwealth of Massachusetts, 600 Washington St., Boston, Mass., plans extensions and improvements in power plant at State Hospital School, Canton, with installation of equipment for increased capacity. Cost estimated close to $100,000.

Montague, Mich. — Hooker Electrochemical Co., Buffalo Ave. and 47th. St., Niagara Falls, N. Y., plans boiler plant at proposed new factory near Montague for production of chlorine and caustic soda. It will comprise several large production units and is reported to cost close to $10,000,000. Work is scheduled to begin early in 1952.

Ontonagon, Mich. — Copper Range Co., 24 Federal St., Boston, Mass., is considering construction of new steam-generating plant at White Pine mining properties, Ontonagon. Details will be determined soon and estimates of cost made.

Aurora, Minn. — Minnesota Power & Light Co., Duluth, Minn., will carry out construction of proposed new steam-electric generating station at Colby Lake, near Aurora, previously referred to in these columns, by company forces, and work will proceed at early date. Station will have an ultimate capacity of 200,000-kw., with initial units estimated to cost $12,000,000. Ebasco Services, Inc., 2 Rector St., New York, N. Y., is consulting engineer.

Virginia, Minn. — Virginia Water & Light Dept., plans expansion and improvements in municipal steam-electric generating station, with installation of equipment for increased capacity. Plans will be prepared soon. Bond issue of $2,500,000 has been authorized for this and extensions in municipal water system.

Wheaton, Minn. — Village Council has plans maturing for new municipal power plant, using Diesel-electric generating units and auxiliary equipment. Proposed to ask bids in near future. Cost estimated about $250,000. Ralph D. Thomas & Associates, Inc., Metropolitan Bldg., Minneapolis, Minn., is consulting engineer.

Henderson, Nev. — Hercules Powder Co., Chemical Dept., Delaware Trust Bldg., Wilmington, Del., plans boiler plant at proposed new factory at Henderson, near Las Vegas, for manufacture of toxaphene and other special chemicals used in production of insecticides. It will comprise several large units and is reported to cost approximately $3,000,000. H. K. Ferguson Co., 1783 East 11th. St., Cleveland, Ohio, is engineer and will be in charge of erection.

Yearington, Nev. — Anaconda Copper Mining Co., 25 Broadway, New York, N. Y., plans power house at new zinc mining works and sulfur plant at Yearington. Project will represent a large development, comprising several units, and is reported to cost over $30,000,000. Work will begin at early date.

Newark, N. J. — Public Service Electric & Gas Co., Public Service Terminal Bldg., is arranging an appropriation of about $150,000,000 for expansion and improvements in plants and system during next 24 mos., 1952–53, including additions in generating capacity at different stations, totaling 475,000 kw., including work now in progress. Also, power substations, transmission and distribution lines and other operating facilities.

Central Islip, N. Y. — State Hospital Dept., State Office Bldg., Albany, N. Y., has approved plans for new power plant at State Hospital at Central Islip. No estimate of cost announced. Bureau of Contracts & Accounts, first noted address, will award contracts and supervise construction.

Springdale, Pa. — West Penn Power Co., West Penn Bldg., Pittsburgh, Pa., will have plans prepared by Sanderson & Porter, 52 William St., New York, N. Y., consulting engineers, for expansion in steam-electric generating plant at Springdale, recently noted in these columns. Installation will include a 135,000-kw. turbine-generator unit, high-pressure boilers and accessory equipment. Cost estimated close to $17,000,000.

North Augusta, S. C. — South Carolina Electric & Gas Co., Columbia, S. C., plans new steam-electric generating plant in vicinity of North Augusta, with turbine-generators, high-pressure boilers and accessory equipment for large capacity. Details will be determined soon. Cost reported over $40,000,000, with power substations, transmission lines and other operating facilities. Project is expected to be completed in about 36 mos.

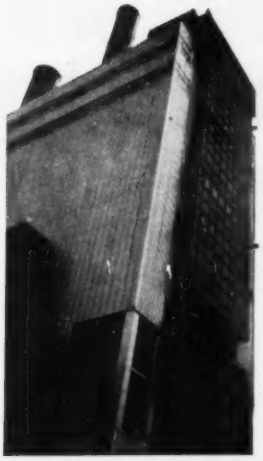
Lebanon, Tenn. — Firestone Tire & Rubber Co., Inc., 1200 Firestone Pkwy., Akron, Ohio, plans boiler house at proposed new plant for automobile tires and tubes at Lebanon. Entire project is reported to cost about $5,000,000. Work is scheduled to be carried out in 1952.

Amarillo, Tex. — Southwestern Public Service Co., Amarillo, has arranged a construction budget to total $65,600,000, during next 36 mos., dating from fiscal year beginning August 1951. Expenditures will aggregate about $21,800,000 during current fiscal year; $23,900,000 in second year; and $19,900,000 in third year. Work will include completion of new 150,000-kw. generating station now under way at Earth, Tex., and other generating plant expansion, power substations, transmission lines and other operating facilities.

San Antonio, Tex. — San Antonio Public Service Bd., 201 North St. Mary's St., has plans maturing for extensions in municipal steam-electric generating plant on Slado Creek, with installation of a new 60,000-kw. turbine-generator unit, high-pressure boilers and auxiliary equipment. Cost estimated in excess of $8,000,000. Gibbs & Hill, Inc., 450 Seventh Ave., New York, N. Y., is consulting engineer.

San Antonio, Tex. — State Bd. for Hospitals and Special Schools, Austin, Tex., plans new power house at State Hospital, San Antonio, for central-heating service. Cost about $150,000. Proposed to begin work soon. Atlee B. and Robert M. Ayres, Transit Tower Bldg., San Antonio, are architects.

Tacoma, Wash. — Dept. of Public Utilities, City Hall, will have plans prepared soon for two municipal hydroelectric generating plants on Cowlitz River. A power dam will be constructed at Mossyrock, Wash., with power station equipped with three 75,000-kw. units; and second dam to be built near Mayfield, Wash., with power house equipped with three 40,000-kw. hydraulic turbines and generators. Entire development is reported to cost about $135,000,000 and will be carried out over a period of several years. Permission has been granted by Federal Power Commission, Washington, D. C.



Keeping Pace With Modern Boiler Design...

One Material Insulates The Entire Job-Better

New boiler installation by Babcock & Wilcox Company, an extension of Toledo Edison Company's Acme Plant, has a rated steam output of 650,000 lb. per hr. at 1500 psi. pressure and 1000°F. temperature. The new boiler is the largest in northwestern Ohio.

Kaylo Heat Insulation—the first basic advancement in the insulating industry in many years—is a hydrous calcium silicate. This remarkable inorganic material (not glass) provides a combination of far-reaching advantages.

With its wide effective temperature range—up to 1200°F.—Kaylo Heat Insulation eliminates the need for combination coverings in nearly all operating conditions. It retains its efficiency and dimensional stability in long service.

Kaylo Heat Insulation is insoluble in water. Its high strength practically eliminates spoilage both in transit and in application. Workmen can walk on insulated equipment without breakage. Yet along with its high strength Kaylo Heat Insulation is light in weight, making it easy to handle and apply.

For complete details on Kaylo Heat Insulation, write Dept. N-280, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

KAYLO HEAT INSULATING BLOCK is made in all standard sizes, up to 18″ wide and in thicknesses from 1″ to 6″. Where necessary, on special order, the block can be shiplapped for broken joint, single-layer application in thicknesses of 3″ or greater.

KAYLO PIPE INSULATION is made to Simplified Dimensional Standards of thicknesses and diameters for snug nesting, when needed. Coverings are sectional for tube and pipe sizes ¼″ to 12″; tri-segmental up to 23″; quad-segmental up to 41″; K-segmental (18″ wide segments) up to 72″ in diameter.

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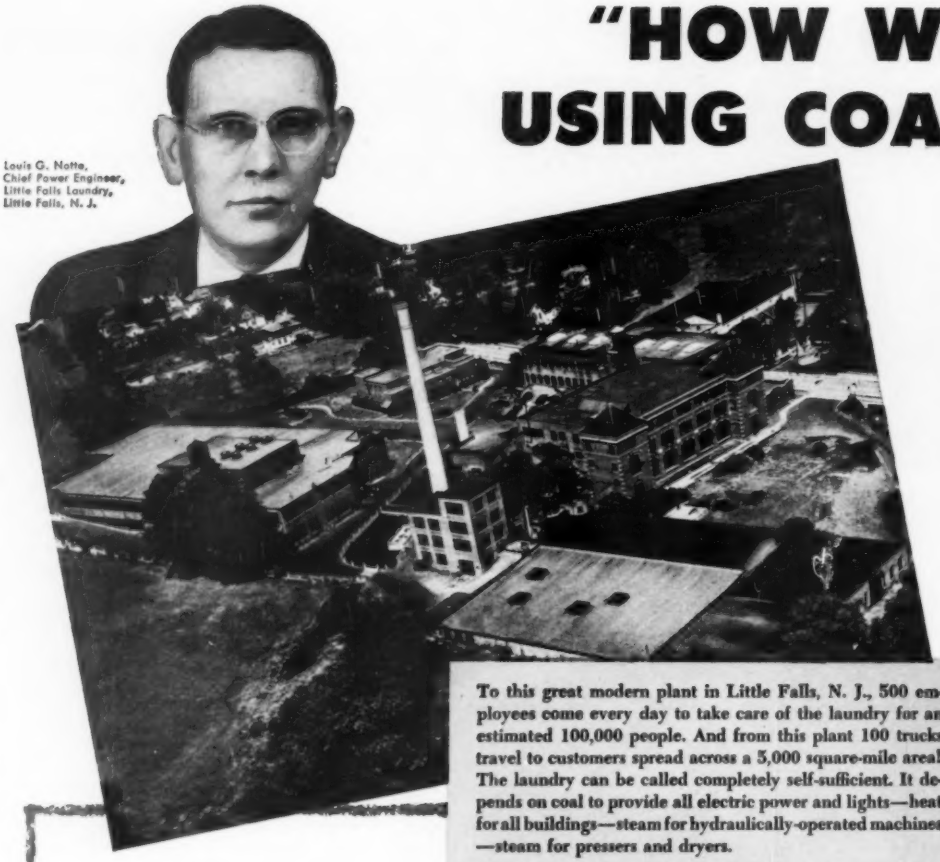
"HOW WE USING COAL



Louis G. Natte,
Chief Power Engineer,
Little Falls Laundry,
Little Falls, N. J.

To this great modern plant in Little Falls, N. J., 500 employees come every day to take care of the laundry for an estimated 100,000 people. And from this plant 100 trucks travel to customers spread across a 3,000 square-mile area! The laundry can be called completely self-sufficient. It depends on coal to provide all electric power and lights—heat for all buildings—steam for hydraulically-operated machines—steam for pressers and dryers.

If you're running your own steam plant, here are a few down-to-earth facts you don't want to miss!

COAL in most places, is today's most economical fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

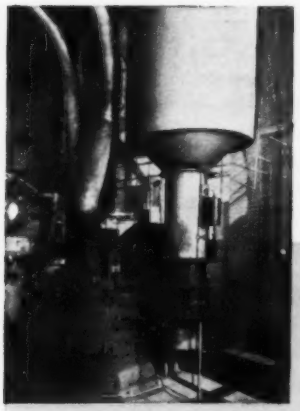
COAL is the fuel that American industry can count on more and more—for with modern combustion-and-handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY
FOR LOW COST

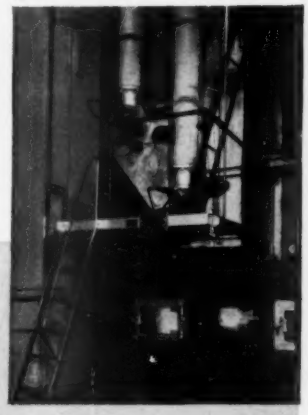
SAVE $20,000 A YEAR—INSTEAD OF OIL"

(ACTUAL CASE HISTORY OF THE LITTLE FALLS LAUNDRY, LITTLE FALLS, N.J.)

"Our laundry is one of the largest in the country," says Chief Power Plant Engineer Notte, "and, we think, one of the most progressive. Our company insists on superior performance at lowest possible cost all along the line. That's exactly why we depend on coal-fired equipment. From coal we get the daily amount of BTU's we need at a cost of $200—to get the same BTU's from oil would cost $280. We can change to oil on less than a day's notice —but so far we've *never* done it. Coal does a great job—cheaper."



This is the company's up-to-date pulverizer from which the ground coal is blown into the boiler. Before this final operation, the laundry employs a steel-slatted conveyor belt to feed a precrusher. From there, power-driven bucket-conveyors carry the coal to the 100-ton storage hopper which feeds the pulverizer. *Modern automatic coal devices of all kinds slash labor costs—make coal's basic economy even greater.*



This is a section of the laundry's modern coal-fired boiler installation. With modern equipment like this it is possible to add anywhere from 10% to 40% to the power derived from the same amount of coal in years past. Actually with coal-fired plants of up-to-date design many companies have brought over-all boiler efficiency up to 85% or more.

● Plants that use coal are in an enviable position —at the present *and* for the future. *For they are more certain than the users of other fuels of a dependable fuel supply—at stable prices.* The reasons are compelling. Of America's total fuel reserves, 92% is coal: Even today, oil is *imported* while this country can and does *export* coal. In addition—this country's mines are the most highly mechanized and efficient in the world.

To get *all* the great economy that coal can deliver—to find out how much more efficient and dependable a job coal and the very latest coal-fired equipment can do—call in a competent consulting engineer. He'll recommend the right equipment for your specific needs. Then you'll see exactly why coal *on a performance basis, on a dollars-and-cents basis* . . . is your best fuel buy, by far!

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A DEPARTMENT OF NATIONAL COAL ASSOCIATION
WASHINGTON, D. C.

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puts the HEAT on heat exchangers

By changing to Yarway Impulse Steam Traps, an oil refinery reports much hotter steam in their heat exchangers **—plus two other important extras:**

(1) They were able to operate the plant with 6 boilers instead of the 8 formerly required.

(2) Three men formerly required to service old-type traps can now be used for productive work.

Significant sidelight—these Yarway traps are operating under severe conditions, many outdoors with temperatures often below zero.

Plant after plant is standardizing on Yarway Impulse Steam Traps because Yarways are designed to deliver the most premium B.T.U.'s at top temperatures into your process or product. **They get equipment hotter, sooner ... and keep it hot.**

Other reasons—small size, easy installation, good for all pressures, only one moving part, low maintenance, low price.

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FREE OFFER. Don't take our word for it. Test Yarway's advantages in your own plant, without cost or obligation. Drop us a card or letter—a trial trap will be delivered promptly.

YARWAY the steam trap
designed with more production in mind

LETTERS TO THE EDITORS

SCREWDRIVERS FOR CONFINED SPACE

I was intrigued by the ingenious screwdriver shown on page 92 of the October issue by F. E. Riley.

However, after reading it, I consider a ratchet screwdriver as being even better for the job, and ratchet screwdrivers can be purchased on the market without going to the trouble of making one.

Herewith is an illustration which was clipped out of a catalog showing what a ratchet screwdriver looks like. It is very much like a ratchet wrench.

They are made for recessed-head screws as well as the ordinary slotted variety of screw. Ratchet handles are also made for interchangeable screwdrivers and adapters for set screws of various sizes.

In some cramped places provision must be made for pressure, as explained by Mr. Riley. With the ratchet screwdriver this can be done in various ways, one of the ways being the use of tapered blocks. Another way would be the use of a small standard jack.

Newark, N. J. W. F. SCHAPHORST

FORCED CIRCULATION

IN PREVIOUS issues, and especially in your annual January review numbers, you have given us readers some very good information about the latest power plant developments, how they fit into what power engineers are doing today and how we can expect to see them develop in the future. You have shown us what we may look for in gas turbines, outdoor power plants, reheat, the cyclone furnace, pressurized furnaces, dual-circulation boilers, the dual-fuel engine, pumped storage and many others, — and now atomic power.

There's one other recent development, however, you haven't said much about lately. That's the forced-circulation boiler. Some time ago you published some good data on the construction and operation of the first forced-circulation boiler at the Somerset station of Montaup Electric Co. But for a long time, not much new information has been coming out on these boilers.

What's the latest scuttlebutt on these forced-circulation units?

Cleveland, Ohio J. P. WARBURTON

Editor's Note:—Latest word is that 17 controlled circulation boilers (as the manufacturer prefers to call them) are now on order, for various utility systems. All are reheat units.

For Public Service Electric & Gas Co., units of 1,015,000 lb per hr of steam are to be installed, for 2650 psi design pressure, 1100 F initial steam temperature. reheat to 1050 F. Philadelphia Electric Co. plans to install units of 1,450,000 lb per hr, 2075 psi, 1000 F/1000F. Consumers Powers Company plans units of 1,050,000 lb per hr, 2300 psi, 1050 F/1000F. Other units on order are: Wisconsin Electric Power Company, 795,000 lb per hr, 2050 psi, 1050 F/1000F; Cleveland Electric Illuminating Co., 875,000 lb per hr, 2030 psi, 1000 F/1000F; Southern California Edison Co., 920,000 lb per hr, 2100 psi, 1000 F/1000F; Wisconsin Electric Power Co., 795,000 lb per hr, 1775 psi, 1000 F/1000F; Duke Power Co., 900,000 lb per hr, 2010 psi, 1000 F/1000F; Virginia Electric & Power Co., 750,000 lb per hr, 1670 psi, 1000 F/1000F.

The Montaup installation pioneered the controlled-circulation high-pressure boiler. The early problems in operating this unit have been solved, it is stated, and this experience has shown how future installations may be designed to be entirely free from the difficulties originally encountered.

WE CAN DO IT, TOO!

THAT ARTICLE New Steam Plant Halves Labor, Cuts Fuel ⅓ for Fairbanks, Morse sounded very sensible and reasonable to us. (October 1951 issue, page 74)

When we engineers saw that article, we checked with F-M, oiled up our slide rules, sharpened our pencils and figured we could do it just as well as they did.

Management received our figures with pleasure, and we're going to have a new steam plant, so help me! — as a direct result of your article.

Chicago, Ill. L. R. S.

INSTRUMENTS? WHAT FOR?

I READ the November article, "Smoke — What Causes It and What To Do About It" with great interest. I refer you to the paragraph in this article in which these sentences are a part, "It should be noted that no reference has been made to carbon dioxide (CO_2) or draft over the fire. These have been omitted because, while these are very important they are only a means to an end and will vary with each different installation." Now if it is taken for granted that each power plant *has* and *uses* these instruments, it should have been noted in this paragraph. Why do I say this? Because I, as a Shift Engineer, tried to sell my boss on putting draft gages on all or one of our five boilers and in buying a CO_2 recorder or Orsat to study a smoke problem. He turned this suggestion down for the identical reason I wanted them. Now, when he sees this article he will think he was right and if he is, I would like to know how you can arrive at some of the answers without these instruments.

On these boilers we had ⅛ in. steam jets which were doing a fair job as far as maintaining the pressure (125 lb) and load is concerned. But we had a smoke problem which prompted my suggestion. I felt that with these instruments and a little experimenting I could eliminate the trouble.

I have studied Fuel and Combustion by Hays, also ICS — ME, and have a power plant library, I believe, second to none. This plus other educational programs during 15 years experience in the power house have given me a fairly good grounding.

The company called in a concern selling a patented gadget, the (Smoke-eater) to be installed on each of the boilers; this cost them $25.00 per unit. They installed 4 units on each of the large boilers and 2 each on the small boilers; plus $100 per boiler installation, and our pipe shop did the work. This cost them $500 for the installation and $400 per month every month regardless of the amount of coal used.

They put in each of the large boilers 12 two-in. air tubes each with a 3/16 in. steam jet to syphon in the patented medicine, also 3 on each of the small boilers. Now we can't carry the load. The pressure falls as low as 75 lb and our biggest user, a forging shop, is forced to suspend work, slow down or have the workers go home which some do. The jets were to be operated at 30 lb pressure but they did not want a regulator on the line and consequently they are open wide most of the time. A little figuring will show it will take most of the steam one of the small boilers will produce. And I personally don't think it did a very good job of eliminating the smoke. All the blame is put on the coal which I don't think is any worse than the top soil we were forced to use during the war. Our over-all load has not changed much, in fact much of our trouble comes when the load is considerably less. Now they have ordered a 25,000 lb per hr oil burning package boiler. I predict they will have trouble with it if they don't pay more attention to combustion on it than they do with coal. We have been using as high as 100 tons of coal a day at $6.65 a ton. The oil they are going to use will cost them 13 cents a gallon.

Our load seldom exceeds 3000 hp for 8 hours. I believe we are using a lot of excess air but without Orsat or CO_2 meter have no way of proving it.

Pennsylvania G. S.

First Atomic Power Plant

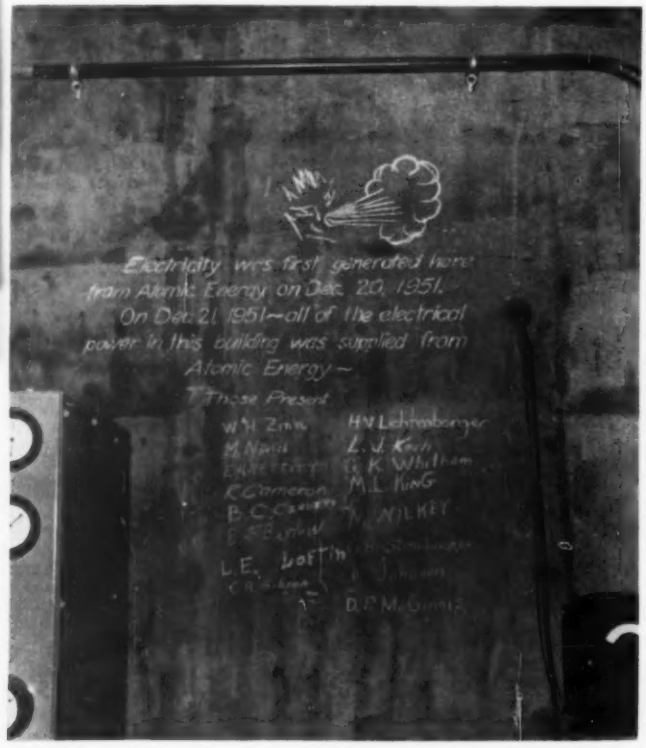
World's first production of electrical power by nuclear energy attained on December 20, 1951 at the National Reactor Testing Laboratory in Idaho. Heat from the Experimental Breeder Reactor was transferred by liquid metal to a heat exchanger where water was turned into steam for use in a conventional steam turbine generating unit which suppled electricity for entire building.

DECEMBER seems to be a fateful month in the development of atomic energy for peaceful purposes. It was on December 2, 1942 that the world's first self-sustaining nuclear chain reacting pile went into operation under the West Stands of Stagg Field at the University of Chicago. Now, once again in the month of December, nine years later, another nuclear reactor, this time the experimental breeder reactor at the National Reactor Testing Station in Idaho, made world history. On December 20, 1951 this reactor together with the electric generating equipment that had been assembled and developed, produced the first useful electric power from atomic energy. The following day, December 21, electrical power of more than 100 kilowatts was generated and the entire building in which the equipment was housed was supplied with electricity from the atomic power plant. So far as is known, this is the first time electric power has been produced in any substantial amount by nuclear energy.

A few months ago, the British Ministry of Supply announced that the atomic reactor at their Harwell atomic research center was heating an 80 office building. They accomplished this by installing a heat exchanger in the air cooling system of the reactor. By means of a by-pass fitted with an adjustable damper the proportion of air flow to the heat exchanger can be varied to maintain desired water temperature. The water is heated to a temperature of around 130 F.

DR. WALTER H. ZINN

Dr. Zinn, the Director of Argonne National Laboratory, Chicago, Ill., over a period of 4 years was the leader of the team of scientists and engineers who designed, constructed and operated the reactor which first produced electricity


Electricity was first generated here
from Atomic Energy on Dec. 20, 1951.
On Dec. 21 1951—all of the electrical
power in this building was supplied from
Atomic Energy—
Those Present
W H Zinn
H V Lichtenberger
L. J. Koch
G. K. Whitham
M. L. King
L. E. Loffin

While the development of the heating plant at Harwell was of great interest, the more recent announcement of the generation of electric power at the Idaho Testing Station by means of nuclear energy is of far greater significance, because of the basic principles embodied in producing steam. The heat energy generated in the breeder reactor is removed by a liquid metal at a temperature high enough to generate steam to drive a conventional turbine generator unit. As will be evident from the photographs on these pages, the turbine generator is exactly the same as if it obtained its steam from a coal- or oil-fired boiler.

This new reactor was designed and is being operated by the Argonne National Laboratory — the research center run for the AEC by the University of Chicago. The tests were supervised by Laboratory Director Walter H. Zinn and H. V. Lichtenberger, the Laboratory Project Engineer for the Experimental Breeder Reactor.

Fig. 1. This is the way the 16 scientists, engineers and assistants who participated in the first known production of useful electric power from atomic energy recorded the event. The writing is on the wall of the power plant room of the new Experimental Reactor building of the AEC Reactor Testing Station in Idaho

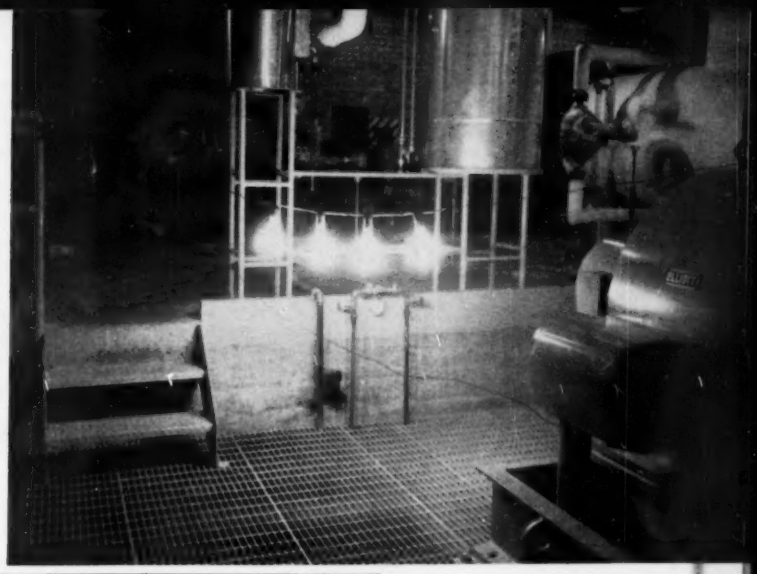


Fig. 2. The light bulbs in this photograph show the first known use of electric power from atomic energy. This photograph was taken on December 20, 1951. The next day, the power was increased to the point where the entire building was supplied from the atomic reactor

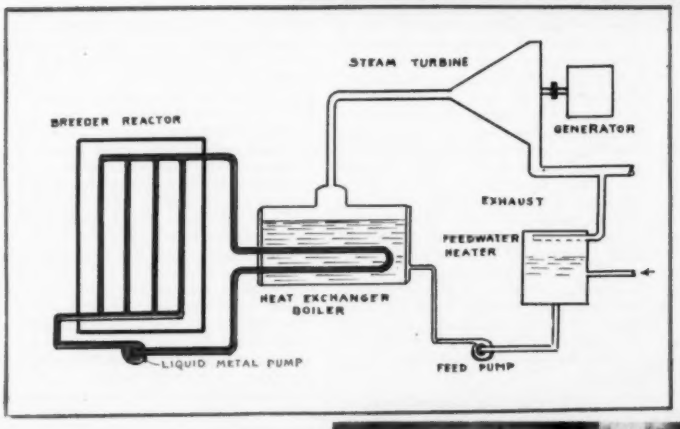
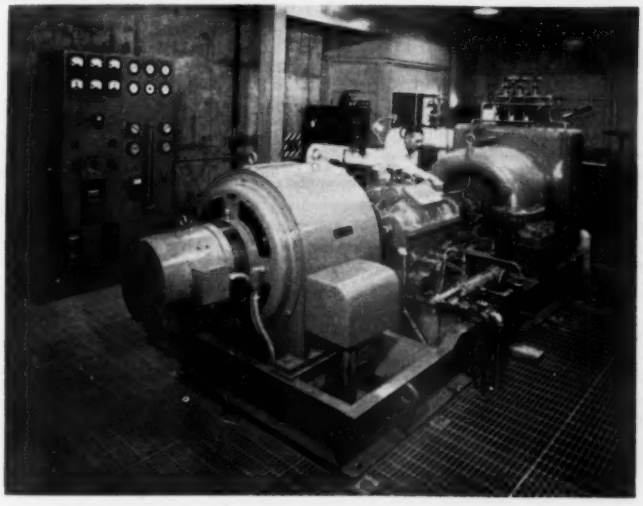


Fig. 3. — Left. Diagram explains the general principle embodied in the Idaho atomic power plant. The breeder reactor at the left is cooled by a liquid metal. The heat so removed is carried to a heat exchanger by the liquid metal and there transferred to the water, converting it to steam. The steam is supplied to an ordinary steam turbine driving an electric generator as shown

Fig. 4. — Below. The turbine generating unit which operates on steam produced by nuclear energy. This is a conventional small turbine-driven generator. This part of the plant is, of course, exactly the same as it is in the case of a conventional fuel fired steam plant

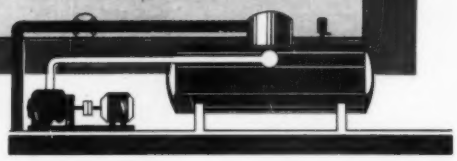


The principal function of the breeder reactor is the long range goal of converting nonfissionable material into fissionable material more rapidly than nuclear fuel is consumed.

The power generation phase is incidental but is being carried out to secure experimental information on the handling of liquid metals at high temperatures under radioactive conditions and on the extraction of heat from a reactor in a useful manner.

Dr. Zinn emphasized that no comparisons should be made of the cost of producing electric power from this reactor with power from conventional sources. Cost was not an essential factor in the power phase of the Idaho reactor and the experiment is in no way intended to establish the feasibility of producing electrical power economically from nuclear sources.

What To Do About Oil in Boiler Feedwater



By **GEORGE S. EMMERSON**

College of Engineering, University of California

IN BOILER PLANTS where condensate from steam engines or steam driven pumps is returned to the boilers, the contamination of the condensate by lubricating oil is a long standing source of trouble. The presence of even a small amount of oil in boiler water often leads to serious operating difficulty since the heat insulating properties of even a thin film of oil on boiler heating surfaces may result in severe overheating. The problem, of course, is one which has long been recognized but it is doubtful whether it is generally appreciated that a thin film of oil on a heating surface is more dangerous than a thick incrustation of scale from a hard feedwater supply.

Sir J. Duston carried out a number of tests on the effect of grease and oil on the transmission of heat through steel boiler plate and some of his results are illustrated in Fig. 1. It will be noted that for a heat transmission rate of 17,500 Btu per su ft per hr, a temperature difference of only 100 F is required if the plate is clean, but with a heavy coating of grease 1120 F difference is required. In these tests it was also shown that when the water temperature was 212 F the temperature of the hot side of the boiler plate was 68 F higher. If, however, the plate was coated with a 0.1 in. layer of grease, the temperature of the hot side was as much as 550 F higher. Various quantitative illustrations of this kind can be quoted to emphasize the remarkable insulating properties of oil and grease. Perhaps it will assist one to realize the significance of an oil film to point out that a layer of oil 1/50 in. thick on a boiler tube operating at 150 psi will increase the tube wall temperature at that point by about 660 F. The strength of mild steel falls off rapidly at temperatures above 1100 deg and the maximum safe operating temperature for boiler steel is usually taken as 900 F. Obviously, a layer of oil might easily cause overheating and consequent failure of the heating surfaces.

Oil in Condensate Arises Mainly With Engines

Contamination of condensate with oil occurs mainly with reciprocating engines. In the engine cylinders, the lubricant is subjected to the washing action of the steam and its viscosity is so reduced by the heat that it is easily caught up in the exhaust and transformed into a fine spray by the velocity of the mixture through the exhaust ports. In the condensate the oil still exists in a state of fine subdivision, in two forms: as minute globules forming a stable emulsion with the water (emulsified oil) and in somewhat larger globules that readily coalesce and settle out from the water (free oil). Of these two forms, the emulsified oil is by far the more difficult to remove. The particles are so small — 10^{-5} cm — that they easily pass through the finest fabric filters.

The oil globules in a two-phase emulsion of oil-in-water carry a negative charge, though the solution as a whole is electrically neutral, hence they repel each other and remain suspended in the water. The origin of this charge has been under discussion for many years and does not particularly concern us. The average value of the charge on each globule was calculated by R. Ellis[1] in 1911 to be about 2.1 x 10^{-4} electrostatic units and for an emulsion of pure oil in pure water. Two per cent is the maximum concentration that can normally be emulsified.

The dilute simple emulsion of oil and water found in steam engine condensate is exceptionally stable and samples have been kept for many years with no tendency to separate. Its properties — size and number of particles and rate of polarization in cataphoresis tests — vary with the type of oil and the conditions of exhaust. No attempt has yet been made to classify these emulsions.

Choice of Oil

Some oils are more susceptible to emulsification than others and it is possible to obtain two samples of oil which are identical according to physical and chemical tests yet which have entirely different emulsifying tendencies.[2]

The problem resulting from the contamination of boiler feedwater by lubricating oil is not as general today as it was when reciprocating engines were used as prime movers. There are still a great many reciprocating engines in use in industrial power plants, and also where exhaust from steam-driven auxiliaries is used for feedwater heating and where condensate is returned from process work the danger of oil contamination is still present. In such cases, what should be done about oil contamination? How can it be eliminated or reduced? What factors are involved in oil contamination and what can the operator do about them? How dangerous is the presence of oil in boiler feedwater? Where does the oil come from? These and a dozen other questions are answered by Mr. Emmerson in this discussion of the subject. Mr. Emmerson, who holds a Master of Science degree from London, England, has devoted a great deal of time and effort in studying this problem during the past four years, and his discussion of the subject will be found very valuable and interesting to every operator of power plant equipment.

[1] Z. Physik Chem., 1911, 78, 321-352.
[2] Philip, J.S.C.I., 34, 607, 1915.

The choice of a lubricant is almost invariably a compromise between the respective advantages of vegetable and mineral oil. The lubricant should form a film on the cylinder wall, adhere to it and retain its properties, regardless of the action of the heat and steam. Then, since it is unavoidable that some of this lubricant will find its way to the exhaust, it should lend itself readily to separation from the steam and be resistant to emulsification.

Pure mineral oils are very resistant to emulsification, but, if used with wet steam, are easily washed away. Fatty, animal, and vegetable oils (tallow, lard oil, degras, etc.), on the other hand, have a greater affinity for water, are not readily washed from the cylinder wall by wet steam, but emulsify easily. The compounded oils represent an endeavour to achieve the desirable properties of both mineral and fatty oils. Experience has shown, however, that except in cases of abnormally wet steam, the "compounding" or fatty oil component should not exceed 10 per cent for effective lubrication, and where an emulsified condensate is especially undesirable the sacrifice of lubricating efficiency due to the use of a mineral oil with wet steam may be acceptable.

As an alternative to compounding, it has been suggested that a straight mineral oil be used with the addition of a little colloidal graphite to assist oil spread. It has been shown that colloidal graphite forms a film in and on the surface layer of the metal and that, since the graphite is more easily wetted by oil than water, the oil spreads more readily over this film than over the bare metal surface and adheres more firmly to it. Graphited oil must not be allowed to reach the boiler tubes, as the qualities that enable it to adhere readily to the cylinder walls will enable it to adhere to the metal surfaces in the boiler.

Method of Lubrication

The method of lubricating the cylinders of a steam engine often has an influence on the tendency to overlubricate. The oil may be fed directly and individually to the cylinders, valves, gland packings etc., or it may be fed to the steam supply on the assumption that in this way the oil will be carried to the rubbing surfaces. The disadvantage of the direct supply method is that the oil is spread over the cylinder surface mainly by the motion of the piston and that uneven lubrication may result, especially if the oil is viscous, leading to excessive oil feed. The alternative, feeding the oil into the steam line, is greatly favored, and it is claimed that the objections to the direct feeding method are thereby avoided. Where the latter method is adopted, the oil should be introduced to the steam flow by some form of atomizer.

In recent years there have been successful attempts to reduce the consumption of cylinder lubricant by plating the cylinder with a suitable metal — porous chrome for instance.

Substitute for Oil

A number of attempts have been made to dispense with oil as a cylinder lubricant, but very little success has been attained where dry steam is employed. With engines operating under saturated steam some success has been attained by using graphite. The powdered graphite — flake graphite tends to clog the piston rings — is dusted on the cylinder, piston, and valves, as the engine is assembled. Sometimes a paste of powdered graphite on a beeswax base is used. No oil is allowed near these surfaces during the process as it prevents their being properly glazed. Once the proper degree of glazing has been attained on the treated surfaces, the moisture in the steam and that due to condensation act as a lubricant. In marine service, it has been common practice to allow cylinder condensation to act as a lubricant, using oil only with superheated steam and a straight mineral oil at that.

are formed from the alkaline sodium salts which are invariably present in treated waters. When any scale-forming constituents, primarily magnesium or calcium carbonate, are precipitated on boiling the water, a considerable proportion does not form scale but remain in the boiler water in a state of suspension. This precipitate coagulates any suspended oil present and, if the oil contains any saponifiable matter, insoluble lime and magnesia soaps are formed. In water-tube boilers, the circulation of the water tends to form thick greasy balls, often called "mud balls", from these sticky oily soaps, by a rolling action through the tubes. These leave a greasy coating wherever they touch a hot surface. The deposits char with the heat and carbonaceous matter left on the metal readily collects more oil and so on.

The presence of soaps or emulsion in the boiler retards the passage of steam bubbles and gives rise to a tendency for the bubbles to lift the water clear of the heating surface for a longer period than would be the

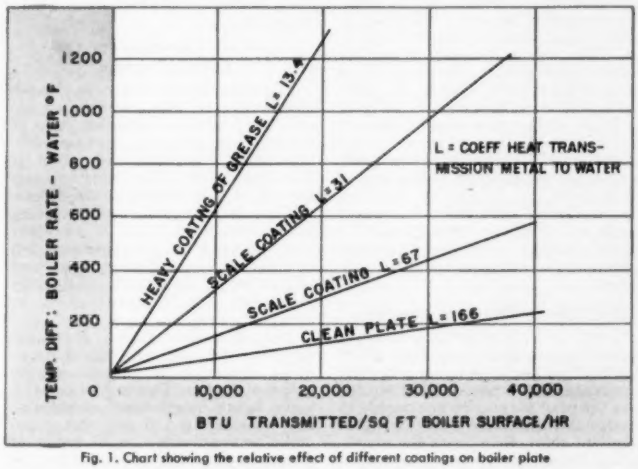


Fig. 1. Chart showing the relative effect of different coatings on boiler plate

Another source of oil in boiler feed water is a raw water supply containing industrial effluent. Many canals, streams, and rivers, are contaminated by the refuse and unwanted by-products of industrial plants, often containing considerable amounts of mineral and animal oil. Often, too, in the autumn particularly, they contain organic material from decaying vegetable matter, much of which is of an oily nature.

Influence of Impurities in Boiler Water Containing Oil

Within the boiler water itself, the presence of other impurities has a considerable influence on the effects of oil. If the oil contains saponifiable matter in addition to the mineral hydrocarbon, as in the case of compounded cylinder oils, sodium soaps

case if the bubbles were allowed greater freedom of movement. The insulating properties of steam need not be stressed. In this case, too, the bubbles free themselves violently and thereby tend to produce priming.

From the point of view of corrosion, pure mineral oil is harmless, but not so the compounded or vegetable oils. The latter are, of course, essentially compounds of fatty acids with glycerine and, under suitable conditions, these are decomposed and liberated in the boiler, producing saponification as already described. When the soaps are formed from sodium carbonate, carbon dioxide is liberated to produce carbonic acid which may cause corrosion, and in this respect a caustic is preferable to a sodium alkalinity. The fatty acids themselves attack iron and steel but

are not nearly so corrosive as the mineral acids. It has been claimed that an alkalinity of 15 grains per gallon is sufficient to arrest boiler corrosion due to acids, either mineral or organic, or that due to magnesium chloride. Sometimes where the raw water make-up is high in permanent hardness, much of the soda introduced in treatment is destroyed by the scale-forming salts and consequently less alkalinity is achieved than desired. Corrosion due to oil, however, is very rare and of negligible importance.

So far, the deleterious effects of impurities in the boiler water have been stressed. It is the case, however, that these suspensions which coagulate the oil frequently sink in a sludge which may then be blown down. The same applies to the formation of a surface scum, which can be removed by a surface blow-down. In fact, certain water treatment specialists advocate the introduction of colloidal suspensions to the boiler in order to facilitate the coagulation and removal of the oil in this way. There still remains the problem of foaming and priming, however, which limits the concentration of solids that a boiler can tolerate in the presence of oil. Then again, if there should be only a little sludge, an oily scale is very readily formed and the percentage of oil in this scale is likely to be much higher than when there is a higher concentration of mineral salts in the water. If, however, the boiler make-up water is composed largely of condensate, as in marine practice, the emulsified oil in the boiler water tends to disperse throughout the water, leading to a fairly uniform deposition of oil over the tube surfaces.

The Tale of The Two Dredges

There is a very striking case recorded[1] concerning two dredges which operated on the same river. This river contained 2 to 3 per cent silt, and it was the practice aboard one dredge to wash out the boilers with raw water from the river. Priming in the evaporators caused some raw water to find its way into the feed water make-up and when the boilers were opened for inspection it was found that a coating of dried silt was present on all surfaces, and no tubes required replacement despite the fact that one gallon of cylinder oil was used per day. The boilers of the other dredge, however, were washed out with distilled water and no raw water was introduced into the feed line. In a period of eight months, 327 tubes had to be replaced due to warping which resulted in damage to the vertical baffles and loosening of tubes in the headers. The boiler manufacturers made all kinds of changes, even to severely reducing the oil consumption, yet the trouble continued. After consulting with the operators of the other dredge it was decided that the boiler feed water was too clean and the feed water treatment was changed accordingly. No further trouble was encountered thereafter.

[1] Brandt, *Trans. ASME* 1947.

It is difficult to obtain evidence of failure due to oil, and many failures attributed to scale formation have probably been due to traces of oil overlooked in examination. Frequently the distortion of the overheated metal is sufficient to break off the scale, and contact with the water returns the metal to normal temperature. In this case the position of the distortion can often be a guide to the cause.

Boiler Tolerance for Oil Contamination

Fire-tube boilers have a greater tolerance for oil than water-tube boilers. The higher evaporation rate of the latter is closely bound up with this, and the positive circulation of the water-tube boiler tends to keep any oil or oily sludge in circulation and is a factor against sedimentation or flotation in the boiler. It is evident that the danger of oil contamination and resultant overheating is a function of the oil present, the feed water treatment, temperature, pressure, and boiler loading.

The American Boiler Manufacturers Association demands a maximum concentration of oil in the boiler of 7 ppm. This is but an arbitrary figure based upon experience, and considering a 5 per cent blowdown as equivalent to 20 cycles of concentration of the boiler water as an average case, the concentration of the oil in the feed water should be less than 0.35 ppm to comply with this specification. The United States Maritime Commission found, in 1942, that the reduction of the oil content of condensate to less than 0.1 ppm was practicable, and on this basis both the Commission and the U. S. Navy set 0.1 ppm as the standard maximum oil content of feed water.

Foaming and Priming

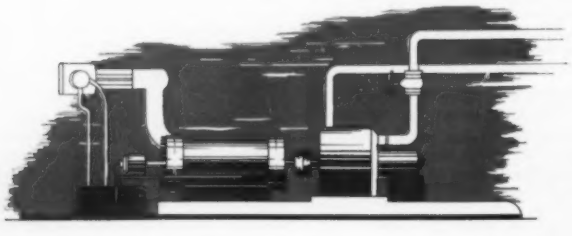
Another effect of oil in boiler water which can lead to serious consequences is that of foaming and priming. These are two distinct conditions often confused one for the other. It would be well to re-define them here: Foaming is the formation of a foam of steam bubbles on the water surface in the boiler. It is a surface condition, and the foam may completely fill the steam space, leading to the carrying over of moisture into the steam lines. Priming, on the other hand, is violent ebullition in which slugs of water may be intermittently carried with the steam, and is the more serious condition.

The presence of oil is not the only factor that may produce these effects. Alkaline solutions in the boiler modify the surface tension of the water and, apart from oil, foaming and priming may thereby occur. It is certain, however, that oil is the most common source of the trouble in a violent form.

The formation of soaps due to oil in an alkaline water has already been explained, and it will be readily understood how these soaps can lead to the formation of a foam of bubbles and froth on the surface of the water leading to carry-over of moisture and suspended impurities with the steam. A surface blow-down helps to control the condition but does not cure it.

When the oil forms an emulsion in the boiler water, priming may result. Here the quantities of water and mineral impurities carried over into the steam line are very much greater as a result of the violence of the ebullition. The following simple experiment illustrates the process: Bring a ball of copper or iron, suspended from a wire, to a white heat; then dip it into a can of clean clear water free from oil, the ball will be quickly quenched with much hissing and evolution of steam. If the procedure is repeated with an oily water, the ball will be slow to quench and very little steam will be given off. The metal will cool more slowly than in the previous test and the shell of vapor will gradually become thinner until it finally collapses with a violent report and the release of a volume of steam.

If the prime mover is a reciprocating engine, the impurities carried over from the boiler due to priming and foaming are deposited in the engine cylinders where they mix with the lubricating oil and interfere with lubrication. When calcium is mixed with oil in a heated condition it forms a greasy mass which is exactly that commonly used as cup-grease. It is suggested that this is the reason why some cylinder oils congeal at lower temperatures after having passed through the engine cylinders. This oil and calcium mixture, often in the



form of a brown soap, finds its way into the condensate and feed system. It also interferes with lubrication of the engine cylinders and causes the operator to introduce more oil, so increasing the oil return to the boiler and so on in a vicious circle.

Castor and pine oils have been used to inhibit foaming and priming with success, particularly in the lower pressure ranges. The effect of these oils is only temporary, however, as they are readily steam distilled. A number of effective anti-foams are now available.

Influences of Prime Mover

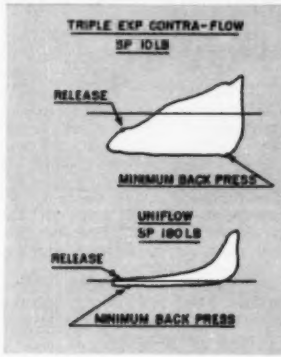
It has been found that the exhaust from a single-expansion uniflow engine contains a much tighter emulsion and less free oil than the exhaust from a multi-expansion contra-flow engine. Of course, high speed and superheat demand more cylinder lubricant, but why should the emulsified fraction of the oil in the condensate be higher and more stable in the case of the uniflow engine?

One theory postulates that the velocity of the steam through the exhaust ports is extremely high and causes the particles to collide, with especially disintegrating effect. Also, it has been suggested that the rate of pressure drop between "release" and the minimum back pressure causes re-evaporation of any moisture in the exhaust and, if the rate of pressure drop is sufficiently high, the action will resemble that of an explosion, and disintegration of the oil particles will result.

In Fig. 2 a typical indicator card from the L-P cylinder of a slow-speed triple expansion engine is compared with one from a medium speed uniflow engine cylinder. It will be seen that the rate of pressure drop between "release" and the minimum back-pressure is very much greater in the case of the uniflow.

It is possible that both the velocity through the exhaust ports, combined with the baffling and turbulence experienced, and the pressure drop described, contribute to the uniflow engine having a high fraction of emulsified oil in the condensate. Then in the ordinary multi-expansion contra-flow engine, comparatively slow speeds prevail, and a greater moisture content is encountered in the exhaust steam as a result of cylinder condensation; factors, it may be presumed, against the formation of a highly emulsified condensate.

In some uniflow engine condensates an emulsified oil concentration of 100 ppm has not been uncommon, though it is not usual to encounter concentrations above about 700 ppm. In the more orthodox types of steam reciprocator this concentration may be no higher than about 3 or 4 ppm.



FROM "RELEASE" TO MINIMUM BACK PRESS	CONTRA-FLOW	UNIFLOW
TIME (SECS)	0.34	0.12
PRESS DROP (PSI)	6	21
RATE OF PRESS DROP (PSI/SEC)	17.6	175

Fig. 2. Typical indicator cards of contraflow and uniflow engines and corresponding pressure drops between release and minimum back pressure

The condensate from a modern turbine is practically free from oil. In this case, the principal danger would lie in some mal-operation of the pressure lubricating system, or if the turbine is at rest, or being brought to rest, oil in the main bearings may then be drawn in by vacuum. In common with reciprocating engine installations, however, oil may enter the condensate from auxiliary machinery, from leakage in shell-and-tube-type fuel oil heaters for instance, or simply from overlubrication and allowing the lubricators to operate after the engine is shut down.

Remedial and Preventive Measures

The possibility of adjusting the feed water treatment so that the suspended oil in the boiler water may be coagulated by sludge and blown down has already been discussed. At one time, too, it was common practice, and may still be with some operators, to introduce oil directly into the boiler in order to avoid, or reduce, the adherence of scale to the metal heating surfaces. Kerosene has been most favored for this purpose, though even tallow has been used. Very often the oil removes the scale all right, but only by causing overheating of the affected surface, leading to the expansion and cracking off of the scale. Porous scale will absorb oil, of course, and kerosene has the advantage, on being absorbed, of evaporating on coming into contact with hot metal. The vaporization of the kerosene is often sufficient to break up the scale. Where high metal temperatures are encountered, the oil is not vaporized but carbonized into a hard sticky mass. The deliberate introduction of oil to the boiler water, then, may be considered very foolhardy.

By far the safest and most desirable aim is the prevention of the oil's entry to the boiler. Free oil and heavy globules of fatty matter can easily be extracted from the feed water by passing the water through simple filters or by merely allowing the water to attain a reasonable state of quiescence in a suitable tank, whereupon the oil settles to the surface. With emulsified oil, these methods are of no avail and other methods of elimination have therefore to be considered. These range from the use of fine porous media and filter aids to the use of chemicals and electricity. Attempts, too, are made to eliminate the oil in the exhaust steam line to the condenser by interception. This is obligatory where the steam is used in certain process operations.

Editor's Note: This is the first of four articles dealing with the problem of oil contamination. The subject of feed water filtration will be considered in a second article to be published in a subsequent issue.

MIDWEST POWER CONFERENCE RENAMED AMERICAN POWER CONFERENCE

THE MIDWEST POWER CONFERENCE has been renamed the American Power Conference, it was announced by R. A. Budenholzer, conference director and professor of mechanical engineering at Illinois Institute of Technology.

The first annual American Power Conference will be held March 26, 27, and 28, 1952 at the Sherman Hotel, Chicago.

Illinois Tech will continue to sponsor the meeting and the same schools and societies will participate:

Iowa State college, Michigan State college, Northwestern university, Purdue university, State University of Iowa, University of Illinois, University of Michigan, University of Minnesota, University of Wisconsin.

Chicago section American Institute of Chemical Engineers, Chicago section American Institute of Electrical Engineers, Chicago section American Institute of Metallurgical Engineers, Chicago section American Society of Mechanical Engineers, Illinois section American Society of Civil Engineers.

Illinois chapter American Society of Heating and Ventilating Engineers, Western Society of Engineers, Engineers' Society of Milwaukee, and the National Association of Power Engineers, the Association of Edison Illuminating Companies and the Edison Electric Institute.

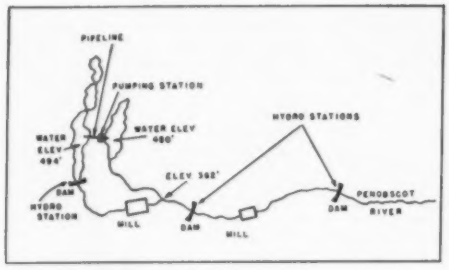


Fig. 1. Schematic map of the water supply situation of Great Northern Paper Co. at Millinocket, Maine, showing how water pumped from Millinocket Lake at lower elevation to Ambajejus Lake at higher elevation runs down through all five of the company's installations to generate an additional 2000 hp

530 hp in Diesel Pumps Adds 2000 hp to Great Northern's Hydro Power

FROM THAT statement, you might get the idea that Great Northern Paper Co. at Millinocket, Maine, has found some way to break the second law of thermodynamics into small pieces or has discovered perpetual motion or something. That, of course, is not the case; but their engineers *have* figured out a most ingenious scheme for getting 2000 hp in additional hydroelectric generating capacity by installing a 530-hp pumping plant, as described below. The scheme is fundamentally a pumped storage development.*

Here is what happened. Great Northern Paper Co., because of the severe drought in New England during the past few years (and especially after three consecutive drought years in Maine, ending in late 1950) found that its water reserves had been sharply depleted. It must have adequate power output for its great newsprint plants at Millinocket and one 30,000-hp hydroelectric power station is now being constructed at Ripogenus, which will supply power for the mills. This plant, however, will not be finished until 1952, so last year the Great Northern engineers studied their existing facilities for quick power possibilities.

The general situation is well shown in the map of Fig. 1. The company has two production mills and three hydroelectric power plants already spread along the Penobscot River. This river derives its water from two main sources: There is a chain of lakes, like that shown at the left of Fig. 1, the last of which is Ambajejus Lake, whose water feeds all five of the plants; and a smaller lake to the right, Lake Millinocket, whose outflow through Millinocket stream joins the river below the first hydroelectric station and the big mill, but ahead of the three other units.

The Great Northern engineers figured that by pumping the water from Lake Millinocket, the smaller lake, overland to the larger lake, Ambajejus, they would be able to realize some 2000 hp from this water when it flowed down the river to the first hydroelectric station and mill. Also, this water would still be available at the points of former use at the former potential.

The difference in elevation between the lower Lake Millinocket at elevation 480 ft and the higher lake, Ambajejus, elevation 494 ft, required only a moderate pump-up of 14 ft plus the various friction heads. An arm of Millinocket Lake extends to within some 600 ft of Ambajejus Lakes, as shown in Figs. 1 and 3, so the distance would not be too great.

Accordingly, the pumping station shown in Fig. 3 was built near the shore of the smaller lake, Millinocket Lake, and the basins of both lakes permit water to be utilized on a combined head of 138 ft at the upper hydro plant and the main mill, and to develop 2000 hp or approximately 13,000,000 kwh per year.

The pumping station contains two diesel-engine-driven pumps of the type shown in Fig. 2. These complete diesel pumping units were supplied by Ingersoll-Rand.

Each pump is a 34-in. APS vertical-propeller axial-flow pump, with a capacity of 45,000 gpm of water at 19 ft total discharge head.

Each pump is driven through right-angled gears by a 265-hp type TS diesel engine. This is a heavy-duty supercharged engine, 4-cycle, 7-by-8½-in., 900 to 1000 rpm, built with 6 or 8 in-line cylinders.

Each pump discharges through a steel pipe line of 54-in. inside diameter, approximately 550 ft long, connecting the two lakes.

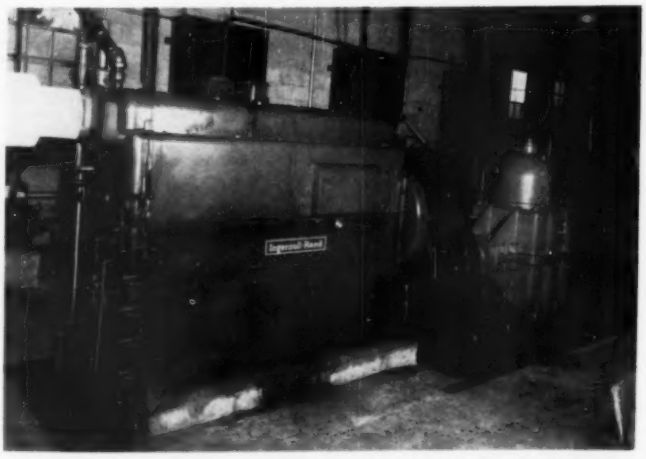


Fig. 2. Interior view of pumping station at Millinocket Lake showing one of the two diesel-driven pumps. Each pump is driven through a vertical reduction gear and has a capacity of 45,000 gpm

* For complete details of the advantages and applications of pumped storage hydroelectric power see article Pumped Storage Hydroelectric Power, by Charles H. Spink, POWER ENGINEERING, October 1951.

Fig. 3. Aerial view of Millinocket Lake pumping station completed and in operation. Pump house and fuel storage tank are in center of picture. Water in background is Millinocket Lake. Ambajejus Lake is shown in center foreground, also outlet of pipes from pumping station

A particularly important factor in this unusual engineering scheme is that the diesel-driven pumps were installed for an estimated $125 per hp, as compared with the cost of a new generating station, which at that time was estimated at $250 to $300 per hp.

In carrying out the project the engineers were careful to inflict no damage on the fishing arrangements in either lake, nor to the various camp sites existing on the shoreline. Another very important item was that provisions were made to discharge the necessary amount of water down Millinocket stream for sanitation requirements.

As the Bangor *Daily News* put it in reporting the construction of this plant, the company utilized the skill of its engineers and a natural water basin to ease the strain of an acute situation . . . Yankee ingenuity at its best.

For data and photographs on this interesting development we are indebted to Great Northern Paper Co., Millinocket, Maine, and to the Bangor *Daily News*.

St. Louis Museum Seeks to Preserve One of Largest Steam Engines

A PROJECT is currently underway to preserve one of the eight largest steam engines ever built. The machine in question is a duplex horizontal-vertical Corliss engine, with cylinders 44 and 88 by 60 in., driving a Westinghouse flywheel alternator. The original rating was 5000 kw, later revised to 7500 kw. Now located in the 74th St. or Manhattan station of the New York City Transit System, a firm commitment for the purchase and removal of this engine must be concluded by the end of February, 1952.

Behind this project is the Museum of Steam & Marine Engineering of St. Louis, Mo., a non-profit association incorporated under the laws of the State of Missouri. Perhaps the best of several alternative plans for exhibiting the engine calls for locating it in a waterworks pumping station when the latter is abandoned a few years hence. One of the six pumps would also be preserved as an exhibit, and the balance of the floor space made available for other engineering relics.

Why This Engine is Important

Besides minor exhibits, the plan would result in the preservation of two of the highest types of early machinery, each particularly noteworthy. The Manhattan engine is an especially fine piece of engineering, aside from its impressive size. For example, it has a riveted plate flywheel. Although the shaft is exceptionally short and stiff (37 in. in diameter) the deflection was accurately calculated, and the vertical cylinders are inclined slightly inward so as to work exactly at right angles to the crankpins.

In virtually every respect it represents the highest development of the steam engine as applied to central station work, and is a credit to its builders, the Allis-Chalmers Mfg. Co. While the Edison Institute of Dearborn, Mich., has many old engines, including early beam engines from England, there appears to be no important direct-connected steam engine generator set preserved anywhere.

Museum Needs Co-operation to Get Engine

The immediate plans of the Museum are to acquire the engine and store it in a temporary structure in the vicinity of the Baden Pumping Station in St. Louis, Mo. Very nearly $60,000 will be required for this proj-

(*Continued on page 100*)

Something New—
A Static Magnetic Exciter

Here is described an exciter for synchronous alternators that has no moving parts and no electron tubes. It is more than an exciter because it is also a regulator. Thus it combines in a single static device both functions of excitation and regulation. A more complete discussion of this exciter was contained in a paper which Mr. Storm presented at the summer meeting of the AIEE in Toronto last June but since much of the paper considered the mathematical analysis of the exciter, we feel that this abstract describing its practical design will be of greater interest to operating engineers. While still in its preliminary stage of development, the model described performs so well, and is so simple in its construction that it has extremely attractive possibilities. These points are well illustrated by the diagrams shown here.

By H. F. STORM
General Electric Company,
Schenectady, N. Y.

ONE of the fundamental functions of a voltage regulator is to keep the terminal voltage of the alternator constant at various loads. To achieve this end, the excitation of the alternator must be related to the alternator line current in magnitude and phase.

It has been shown [1] that the line-to-neutral voltage drop ΔE equals

$$\Delta E = -jX_s I \qquad (1)$$

where X_s is the synchronous reactance of the alternator, and I is the line current. This equation assumes a cylindrical rotor, no saturation, and no resistance of the armature winding. It is interesting to note that a typical alternator has a voltage drop ΔE in the vicinity of rated terminal voltage when loaded with rated line current at zero power factor. This is a very large voltage drop by comparison with a d-c generator which has a typical regulation of only 4 per cent of rated terminal voltage. It follows that the excitation of an alternator has to cover a relatively wide range, and as a result, alternators usually require high-gain regulators which often pose stability problems.

[1] Theoretical Elements of Electrical Engineering; C. P. Steinmetz, Third edition, 1909. Page 129.

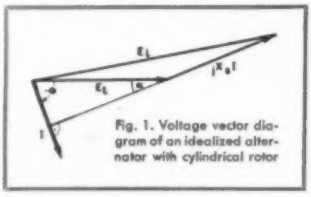


Fig. 1. Voltage vector diagram of an idealized alternator with cylindrical rotor

The excitation described here, however, avoids the need of a high-gain regulator by attempting inherent compensation for the voltage drop ΔE. To compensate for the voltage drop ΔE, the excitation is required to provide an inner (fictitious) voltage E_i such that

$$E_i = E_t + jX_s I \qquad (2)$$

as shown in Fig. 1. This inner voltage E_i is proportional to the field (excitation) ampere turns $I_f N_f$

$$E_i = k(I_f N_f) \qquad (3)$$

where I_f is the field current of the alternator, N_f the number of turns per field pole, and k is a factor involving the number of machine constants, such as the number of turns in the a-c winding, size of air gap, and so forth.

When saturation is present, or for an a-c winding whose resistance is not negligibly small, or when the alternator is of the salient-pole type, deviations from equation 2 will occur. To correct for these deviations, means are provided, nevertheless, equation 2 remains of fundamental importance for the compensation of the alternator voltage drop ΔE.

Voltage-Drop Compensation

Voltage-drop compensation is obtained by a field current I_f which is proportional to the magnitude of E_i, which in turn is determined by the terminal voltage E_t and the alternator alternating current I as shown in Fig. 1.

In Fig. 2 is shown a 3-phase alternator, connected through three identical current transformers CT to the load. There are also three identical, linear reactors X_1 which are interconnected with the secondaries of the current transformers to three identical resistors R. These resistors symbolize the resistance of the alternator field and it can be shown that the current through the resistors R is proportional to E_i.

Assuming a symmetrical 3-phase load, points 7 and 8 of Fig. 2 will be at the same potential as the neutral 0 of the alternator. By connecting 7 and 8 to the neutral 0, no changes in the system currents will occur; the system, however, degenerates into three single-phase systems, Fig. 3, which are simpler to analyze.

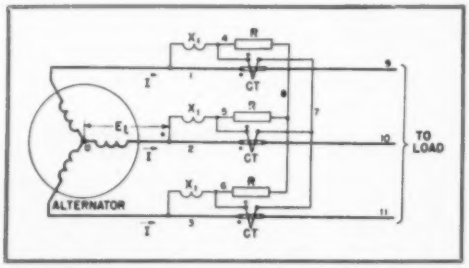


Fig. 2. Three-phase network to reconstruct the internal alternator voltage E_i

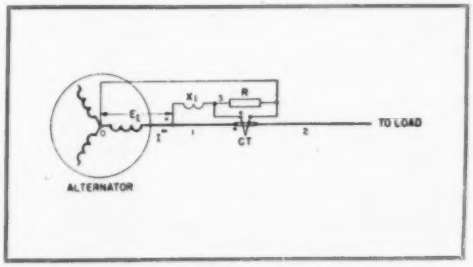


Fig. 3. Single-phase portion of the 3-phase network of Fig. 2

The current transformer CT of Fig. 3 is shown by its equivalent circuit in Fig. 4 when winding resistances and leakage reactances are neglected. Resistor R is the same as shown in Fig. 3, and X_2 is the magnetizing reactance of the secondary of the current transformer CT. Denoting the turn ratio of primary to secondary turns

$$N_p/N_s = a \qquad (4)$$

the alternator current I when referred to the secondary of the current transformer becomes I′

$$I' = aI \qquad (5)$$

The equivalent circuit of Fig. 3 is now shown in Fig. 5. The quantity to be determined is the current I_R which will appear finally to be proportional to the field current I_f.

Acting in the circuit are the terminal voltage E_t and the referred alternator current aI. Accordingly, the current I_R can be seen to consist of two components of which $I_{R,E}$ is derived solely from E_t, and $I_{R,I}$ is derived solely from I

$$I_R = I_{R,E} + I_{R,I} \qquad (6)$$

No attempt will be made here to show how $I_{R,E}$ and $I_{R,I}$ are determined but those interested in the details will find them in my original paper presented before the AIEE[3]. A vector diagram of the currents, however, is shown in Fig. 6. By proper selection of X_1, X_2 and a, the ratio of $I_{R,I}/I_{R,E}$ can be made identical to the ratio $X_1 I/E_t$; hence the vector diagram OAB becomes similar to OCD. The resultant current I_R, equation 6, will therefore be proportional to the required excitation at any terminal voltage and at any load. By rectifying the current I_R, the alternator field current I_f is obtained.

Correction Circuit

The field current I_f will compensate for most of the inherent alternator voltage drop, equation 1, but does not produce a perfect compensation for the drop, because the actual alternator deviates to some extent from the assumption previously made; furthermore, the alternator field resistance is subject to variation due to temperature changes, which will affect the alternator terminal voltage. To obtain the desirable high degree of alternator voltage constancy, a correction consisting of a voltage-sensitive circuit is superposed on the excitation system. This correction circuit modifies the magnitude of the current I_R and, hence, the field current I_f. Because the excitation system (without correction) makes the alternator nearly self-regulating, only a small amount of gain is now necessary for the superposed correction circuit. As a result of this low gain, antihunt means are not necessary.

The magnitude of I_R varies with X_2. By applying d-c ampere-turns to the current transformer CT of Figs. 2 and 3, saturation can be effected in the cores resulting in a change of X_2 and subsequently a change of I_R.

A schematic diagram of such a transformer, called a saturable current transformer and designated by S-CT, is shown in Fig. 7. A 3-legged core structure is used. The primary a-c windings are between terminals X_1, X_2, and the secondary a-c windings are between terminals H_1, H_2. The d-c control winding with its terminals F_1 F_2 is wound around the center leg. Because of the polarities of the windings, the a-c fluxes of fundamental frequency and higher, odd harmonics circulate between the outer legs, and no voltage of fundamental or odd frequency is induced in the control winding. A group of three such saturable current transformers is shown in Fig. 8, which is the complete excitation circuit. Instead of having points 4, 5, and 6 connected to the resistors R (Fig. 2) they are now connected to a three-phase bridge rectifier 1REC which energizes the field of the alternator. The control windings of the saturable current transformers are connected in series and terminate at 14 and 15.

To superpose corrective action on the excitation system, the control windings of the saturable current transformers are energized from a

(*Continued on page 108*)

[3] AIEE Transactions, Volume 70, 1951.

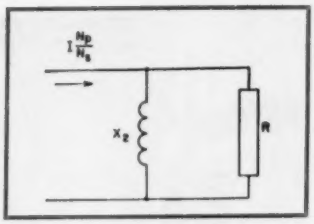


Fig. 4. Equivalent circuit for idealized curren transformer CT of Fig. 3

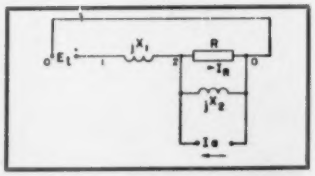


Fig. 5. Equivalent circuit for the single-phase network of Fig. 3

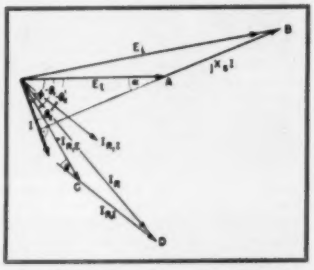


Fig. 6. Vector diagram of currents obtained from the single-phase circuit

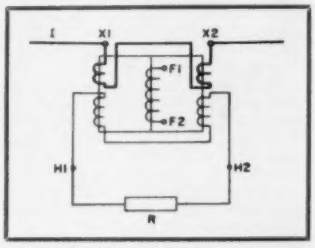


Fig. 7. Schematic of a saturable current transformer

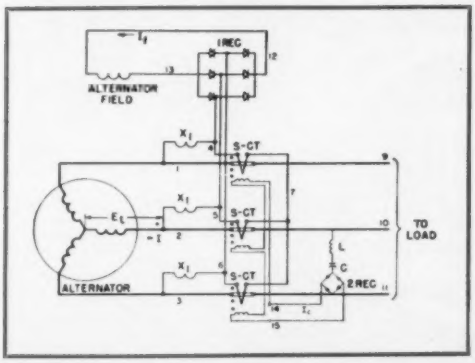


Fig. 8. Circuit of the static exciter, including correction circuit

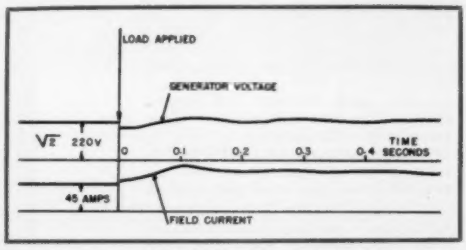


Fig. 9. Alternator is suddenly loaded with one-half of rated current at a power factor of 0.4 inductive

Automatic

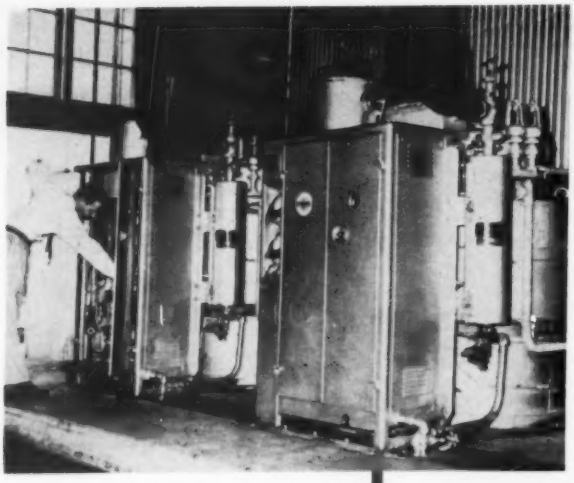


Fig. 1. These two Vapor-Clarkson steam generators in the Norfolk Southern Carolina Junction shops at Norfolk, Va., supply 75 to 300 psi steam for all purposes as shown by other photographs on these two pages

AUTOMATIC steam generators have been widely used on the railroads to furnish high pressure steam for heating diesel powered passenger trains. On the Norfolk Southern Railway, J. H. Wilson, Chief Mechanical Officer, reasoned that if the Vapor-Clarkson steam generators they used on their trains could make enough high pressure steam to heat the trains, they also could make steam for supplying forging hammers, steam-jet guns, hot tanks, and building heat. So two Model 4625 Vapor-Clarkson units were installed in the Norfolk Southern's Glenwood Shops in Raleigh. These worked out so well that, recently, two larger models (No. 4740) of the same make were installed in the Carolina Junction shops in Norfolk, Va., replacing two large standard type boilers.

Analysis of steam costs with the new generators, taking into account labor, fuel, water, maintenance, water treatment and insurance, indicates that they are saving over $1000 per month, a saving that will pay for the generators in a year. On labor alone, four full-time men were transferred from boiler maintenance to other shop work. Now, one man takes about 30 min per working day to start, check and blow down the two steam generators. No standby or week-end labor costs are involved as the units are turned off when not in use.

One of these 4740 steam generators makes almost 5000 pounds of steam an hour, and one unit will supply shop steam under normal shop operations in the summer. In the winter, or when the shop steam load is heavy, both units turn on. About 240 gallons of water are used per average day — about one third of the amount of water previously used.

These generators supply 150 psi steam to two steam hammers, hot tanks, injectors, building heating, and for locomotive blowing. The steam hammers, one weighing 3300 lb with a 33-in stroke and 14-in bore, the other weighing 700 lb for small jobs, need steam at 150–175 psi. The steam locomotive blowers use ¾ steam lines, wide open for 45 min when firing up locomotives. The shop has four blowers.

There are 2 alkaline tanks, each 15 by 4 by 6 ft heated with open steam pipes. For locomotive washing a steam pump is provided to furnish 300 psi hot water. Steam is also used in the Sellers Injector cleaning guns for cleaning pistons, air brake parts, etc, and in three 200 gal filter cleaning hot tanks. For building heating, the steam is distributed at 40 psi.

Fuel costs for a recent month showed that 20 gal of fuel were used per hour per 8-hour day, much less than with the original boilers. Full operating steam pressure is developed in 2 min after the steam generators are turned on. Since the generators are only about ⅓ the size of the old boilers, they were merely mounted on a concrete base, hooked up to fuel

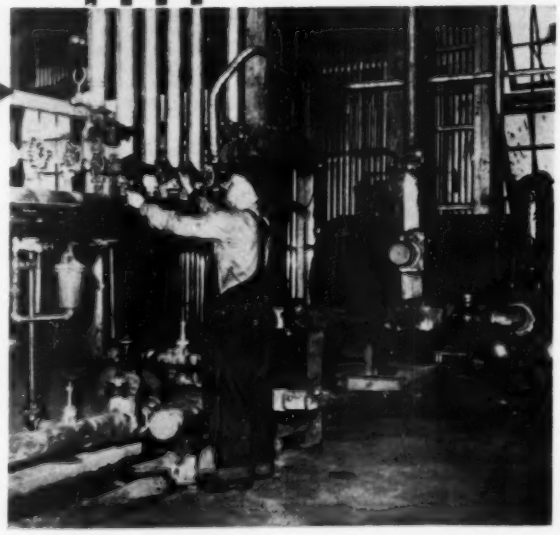


Fig. 2. The steam from the generators is distributed to the various services by means of this steam header. Six inch lines from this header supply the steam hammers. Background shows a 300 psi pump

Steam Generators Save $1000 a Month

and water lines, thus saving on installation costs.

Since less water is used, less water treating material is used. No condensate is returned to the boiler, and the Dearborn system of treatment used gives good results with the 100 per cent makeup. With the original boilers, four full-time men took care of the boilers. Four times 40 hr equals 160 hr plus another man for 8 hr make 168 hr per week. Now one man takes about 30 min a day to start the steam generators and check them occasionally during the day but he is free to do other things. The four other men were reassigned to other shop work. Insurance costs on the Vapor-Clarkson generators also are lower than on the old boilers because of the automatic safety features of the new units. In short, these steam generators are doing a fine job, making ample steam for all shop and building heat, even with the two steam hammers operating at once.

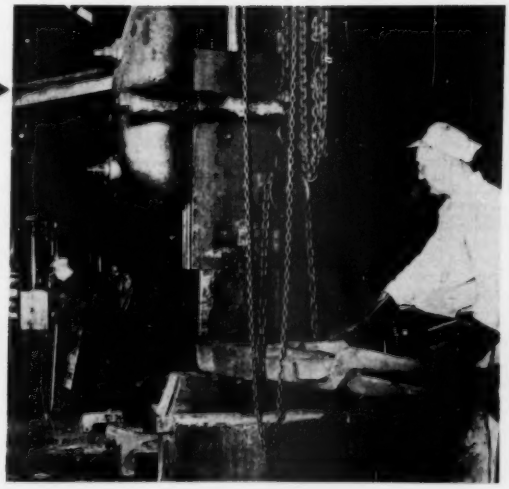


Fig. 3 (Top). Steam is used to heat water which is then pumped at 300 psi to this pressure washing gun. Steam, at 40 psi, is also used to heat the buildings shown in the background

Fig. 4 (Lower right). In the foreground is the 3300 lb steam hammer and in the background, the 700 lb hammer. One of the steam generators can supply more than ample dry steam to operate these hammers for sustained periods

Fig. 5 (Lower left). Steam at 100 psi out of a ¾-in pipe is used to create a draft to speed up the firing of steam locomotives, which takes about 45 min

Relativity in Power Plant Economics

Differences in investment costs dealt with directly rather than calculating fixed charges on estimated total costs. Costs of energy computed, using 850-psig, 900-F regenerative cycle as a base. . . . Factors affecting investment costs. . . . Increases and decreases in costs of fuel and other factors. . . . Calculation for 1450-psig, 1000/1000-F reheat cycle

By **WILLIAM C. ROWSE,** Consulting Mechanical Engineer

IN DECIDING upon the steam conditions and cycle for a proposed steam electric generating station, a number of fundamental factors must be taken into consideration including reliability, economics, system requirements, estimated future fuel prices and any special or local factors.

This article deals exclusively with the economic considerations and more particularly with the *relative* economic characteristics of the following throttle pressure-temperature conditions and cycles (hereinafter for purposes of brevity referred to simply as "cycles").

1. — 850-psig 900-F straight regenerative cycle
2. — 1250-psig 950-F straight regenerative cycle

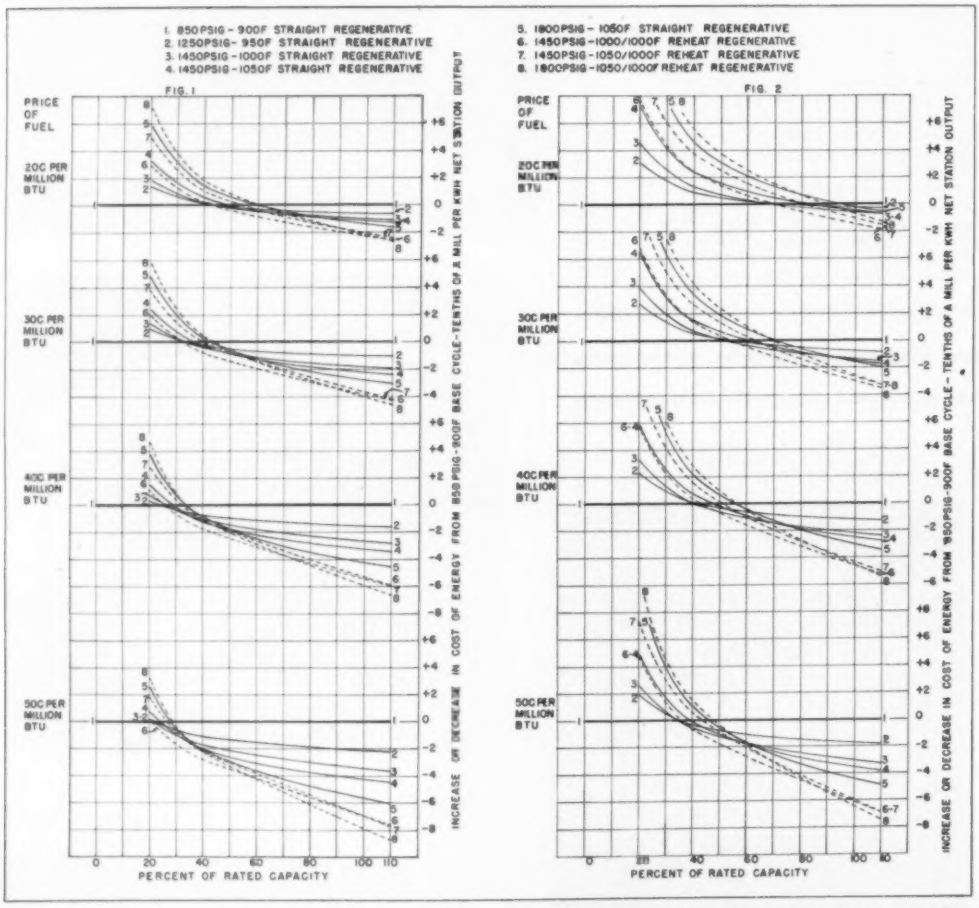

1. 850 PSIG - 900F STRAIGHT REGENERATIVE
2. 1250PSIG - 950F STRAIGHT REGENERATIVE
3. 1450PSIG - 1000F STRAIGHT REGENERATIVE
4. 1450PSIG - 1050F STRAIGHT REGENERATIVE
FIG. 1
PRICE OF FUEL
20C PER MILLION BTU
30C PER MILLION BTU
40C PER MILLION BTU
50C PER MILLION BTU
INCREASE OR DECREASE IN COST OF ENERGY FROM 850 PSIG-900F BASE CYCLE - TENTHS OF A MILL PER KWH NET STATION OUTPUT
PERCENT OF RATED CAPACITY
5. 1800PSIG - 1050F STRAIGHT REGENERATIVE
6. 1450PSIG - 1000/1000F REHEAT REGENERATIVE
7. 1450PSIG - 1050/1000F REHEAT REGENERATIVE
8. 1800PSIG - 1050/1000F REHEAT REGENERATIVE
FIG. 2
PRICE OF FUEL
20C PER MILLION BTU
30C PER MILLION BTU
40C PER MILLION BTU
50C PER MILLION BTU
INCREASE OR DECREASE IN COST OF ENERGY FROM 1850PSIG-900F BASE CYCLE - TENTHS OF A MILL PER KWH NET STATION OUTPUT
PERCENT OF RATED CAPACITY

Fig. 1. Relative costs of energy per kilowatt-hour net station output from 850-psig, 900-F regenerative cycle as base. Six per cent annual fixed charges on investment

Fig. 2. Relative costs of energy per kilowatt-hour net station output from 850-psig, 900-F regenerative cycle as base. Twelve per cent annual fixed charges on investment

Table I. Basic detailed characteristics of steam plant used as example. Based on 90,000-kw, 3600-rpm tandem-compound turbine generator units with 10 per cent overload capacity

Pressure, Temperature & Cycle	Number of Heaters	Feed-Water Temp. Deg. F	All at Rated Capacity: Per cent Power Req'd. by Auxiliaries	Per cent Efficiency of Steam Gen. Unit	Btu/Kwh Chargeable to Cycle	Btu/Kwh Gross Generation	Btu/Kwh Net Station Output	Decrease in Btu per Kwh Net Station Output From 850–900 Cycle	Increase in Investment Cost per Kw Capacity Over 850–900 Cycle
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(k)
(1) 850–900 Straight Regenerative	4	402	6.97	87.5	9365	10703	11600		
(2) 1250–950 Straight Regenerative	5	437	7.51	87.5	8930	10206	11110	480	$ 3.98
(3) 1450–1000 Straight Regenerative	5	450	7.79	88.0	8695	9892	10810	805	5.77
(4) 1450–1050 Straight Regenerative	5	450	7.60	88.5	8575	9689	10560	1025	9.17
(5) 1800–1050 Straight Regenerative	5	480	7.68	90.0	8430	9367	10180	1420	15.31
(6) 1450–1000/1000 Reheat Regenerative	5	447	7.03	89.0	8350	9382	10050	1560	8.97
(7) 1450–1050/1000 Reheat Regenerative	5	447	6.97	89.0	8281	9304	9960	1645	13.18
(8) 1800–1050/1000 Reheat Regenerative	5	480	7.00	90.0	8141	9046	9700	1930	18.45

3. — 1450-psig 1000-F straight regenerative cycle
4. — 1450-psig 1050-F straight regenerative cycle
5. — 1800-psig 1050-F straight regenerative cycle
6. — 1450-psig 1000/1000-F reheat-regenerative cycle
7. — 1450-psig 1050/1000-F reheat-regenerative cycle
8. — 1800-psig 1050/1000-F reheat-regenerative cycle

Relativity the Keynote

This article does not take the place of the economic study that must be made for each specific steam plant, but rather contributes to the general background regarding economics of steam electric generating plants. Relativity is the keynote which has been adhered to throughout. Instead of calculating the annual fixed charges on the estimated total investment cost and computing the total annual fuel costs on the basis of estimated total kilowatt-hours per year, differences in investment costs and efficiencies are dealt with directly and the results obtained are differences in cost per kilowatt-hour of net station sendout. This method adds greatly to the accuracy and simplicity of the calculations and the presentation of results. Attention is called to the fact that the estimated differences in investment cost are at the estimated average cost level for the two years 1951 and 1952.[1]

Illustrated Example in Table I

For purposes of illustration, relative economic studies, with the 850 psig-900 F straight regenerative cycle as a base, were made for each of the other cycles listed above. These were applied to a steam electric generating station employing 3600-rpm tandem-compound turbine generator units of 90,000 kw rated capacity with 10 per cent overload capacity similar to the ASME-AIEE preferred standards for smaller units; the unit system of one boiler per turbine; pulverized coal for fuel; cooling towers for condenser cooling water; and other characteristics as shown in Table I.

The estimated net increase in investment cost per kilowatt of rated capacity of each of the cycles (2) to (8) inclusive over the 850 psig-900 F base cycle was considered to be caused by variations in the following only, the remainder of the plant cost being considered the same for all cycles:

Increases in Investment Cost Due To:

(a) Steam generating unit (boiler) and appurtenances.
(b) Turbine generator unit.
(c) Feedwater pumping and heating equipment.
(d) Power piping.

Decreases in Investment Cost Due To:

(e) Condenser and pumps.
(f) Circulating water supply.
(g) Coal pulverizing and handling equipment.

The net increase in investment cost per kw of rated capacity is the algebraic sum of the above.

The costs available to the author were for an economic study made in 1948 and 25 per cent was added to the net increases in investment cost per kilowatt of rated capacity to bring them up to the average cost level for the two year period of 1951 and 1952.[2]

Decrease in Btu per Kwh

The Btu per kwh chargeable to the cycle at rated capacity for each of the eight cycles were based on data from the same source as the relative turbine generator costs and included the necessary data to calculate and plot a curve of the Btu chargeable to each cycle over the entire range from 20 to 110 per cent of rated capacity. Dividing by the overall efficiency of the steam generating unit gave the Btu per kwh of gross generation. This latter was in turn divided by 100 per cent minus the estimated per cent of power required for station use (obtained from a special study) to give the Btu per kwh of net station output for the range of loads from 20 to 110 per cent of rated capacity. The decrease in Btu per kwh net station output for each of the cycles (2) to (8) inclusive from the 850-psig 900-F

(Continued on page 110)

[1] See article What Will Future Steam Power Plants Cost? by William C. Rowse, February, 1951, POWER ENGINEERING.

[2] Rowse, *Ibid.*

Table II. Sample calculation sheet. Relative costs of energy, using 850-psig, 900-F regenerative cycle as base, for 1450-psig, 1000/1000-F reheat regenerative cycle using 12 per cent fixed charges. (+) indicates increase in cost over base; (−) indicates decrease in cost from base

Per Cent of Rated Capacity		20	40	60	80	100	110
PER KW OF RATED CAPACITY							
1 Increase investment cost over base						$8.97	
2 Kwh per year net station output		1335	2885	4330	5950	7420	8240
3 Decrease in Btu per kwh from base		940	1000	1130	1310	1560	1700
4 Increase in annual fxd. chgs. over base						$1.08	
5 Increase in annual maint. chgs. over base						0.09	
6 Total of (4) and (5) above						$1.17	
FUEL PRICE, CENTS PER MILLION BTU	MILLS PER KWH NET STATION OUTPUT						
↓	7 Increase in fixed charges and maintenance over base	+0.951	+0.440	+0.293	+0.213	+0.171	+0.154
20	8 Decrease in fuel cost from base	−0.188	−0.200	−0.226	−0.262	−0.312	−0.340
	9 Net increase or decrease from base	+0.763	+0.240	+0.067	−0.049	−0.141	−0.186
30	10 Decrease in fuel cost from base	−0.282	−0.300	−0.339	−0.393	−0.468	−0.510
	11 Net increase or decrease from base	+0.669	+0.140	−0.046	−0.180	−0.297	−0.356
40	12 Decrease in fuel cost from base	−0.376	−0.400	−0.452	−0.524	−0.624	−0.680
	13 Net increase or decrease from base	+0.575	+0.040	−0.159	−0.311	−0.453	−0.526
50	14 Decrease in fuel cost from base	−0.470	−0.500	−0.565	−0.655	−0.780	−0.850
	15 Net increase or decrease from base	+0.481	−0.060	−0.272	−0.442	−0.609	−0.696

Alex Bailey Retires from Commonwealth Edison

Veteran power engineer retires after 48 years of service. Other important changes in top management also announced. Titus LeClair becomes Manager of Engineering

IMPORTANT promotions in system operating officials of Commonwealth Edison Co. were announced recently by Charles Y. Freeman, Chairman. Two veteran vice-presidents, Alex D. Bailey, after 48 years of service, and Curtis A. Lambert, after 45 years, will retire February 1.

In a new organization alignment affecting system engineering and related activities, Raymond D. Maxson, now engineering Vice-President of Public Service Co. of Northern Illinois, was also elected Vice-President of the Edison Co. Mr. Maxson will thus be in charge of corresponding work in both companies.

The organization under Mr. Maxson, in both companies, will be divided into four subdivisions in charge of newly created executives who similarly will have corresponding duties in each company. The new posts will be held by men who have had long experience under Mr. Bailey and Mr. Lambert. They are:

Manager of Engineering
Titus G. LeClair
Manager of Construction
John F. Sullivan, Jr.
Manager of Power Production
Vern L. Stone
Manager of Power Supply
Earle Wild

Mr. Maxson, 53 years old, graduate in electrical engineering, University of Illinois, started work with the Public Service Company of Northern Illinois at Crystal Lake in 1921. He worked in the engineering departments of that Company in various district offices in different capacities progressing to the rank of Division Manager in 1936, and to Vice-President in 1943. Mr. Maxson has been active for many years in the work of the American Institute of Electrical Engineers and the Western Society of Engineers. Mr. and Mrs. Maxson have lived in Elmhurst for over 25 years. They have two sons, one a student at Purdue University and the other at the University of Illinois.

Mr. LeClair, age 52, Manager of Engineering, joined the Edison Co. in 1923, and has been Chief Electrical Engineer for the past two years. He is a graduate of the University of Idaho, and past president of the American Institute of Electrical Engineers and of the Western Society of Engineers.

Mr. Sullivan, age 49, Manager of Construction, came to the Edison Company in 1925 as a graduate in mechanical engineering, University of Wisconsin. For the past several years, he has served as Mr. Lambert's assistant. Mr. Sullivan is a past president of the Illinois Engineering Council and is Treasurer, Western Society of Engineers.

Mr. Stone, age 50, Manager of Power Production, has been with the Edison Company since 1924. He obtained his technical education at Lewis Institute and at Armour Institute. Mr Stone has spent his entire time with Edison in generating station work, advancing to the position of Superintendent, Generating Stations in 1951.

Mr. Wild, age 49, Manager of Power Supply, entered the Edison Company in 1924. He is a graduate of the Massachusetts Institute of Technology. Mr. Wild has been directing the load dispatching work under Mr. Bailey's guidance, for the past several years. During the war, he served W P B as Power Coordinator for the New England and other east coast states.

Mr. Freeman also announced that John R. Michel, age 52, was appointed a staff assistant to Mr. Maxson with the title, General System Engineer, and Myron Lukey, age 42, will continue to be a staff assistant to Mr. Maxson as Administrative Engineer. Michel has been with the Edison Company since 1923, and recently has been assistant to Mr. Bailey, while Lukey has been associated with Public Service Company since 1925.

Curtis A. Lambert

Alex D. Bailey

Raymond D. Maxson

Titus G. LeClair

Vern L. Stone

John F. Sullivan, Jr.

Earle Wild

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

NOTE ON A NEW TWIST

In power engineering where vast quantities of steam, water, air, and electrical energy are handled, little things add up to large totals. A few parts per million of solids in the feedwater, for example, can spell disaster so far as boiler operation is concerned. Knowledge of the value of such little things is reflected in a detail in the design of new steam turbines. This involves a slight change in blade shape. In addition to their air-foil section and taper from root to tip, the blades are given a slight twist. This twist causes the steam to pass directly through the many stages without accumulating any radial movement. Steam does not *pile up* at the outer ends of the passages due to centrifugal force. This technique is called constant circulation. It is not new, since it was introduced 15 years ago in the long exhaust stages of big machines. Lately, however, as reported by Westinghouse, it has been extended to turbine stages having blade heights as short as five inches. By improving efficiency, the turbine engineers garner some additional Btu's, and where so many millions of pounds of steam are involved this is important. A disadvantage of the technique, however, is the increased cost of manufacture. We get nothing for nothing in this world.

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Technical Publishing Company

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How To Solve Obstinate Problems*

By ZUCE KOGAN

WHEN you are confronted with a problem, just what do you do? How do you go about solving it? If you do solve it, after you have arrived at the successful solution, do you know how you did it? Was it because of your experience, your education, your intuition, your imagination, or was it just a lucky guess? Perhaps you will attribute your solution to your general knowledge, but if it was, just how did you translate your general knowledge into terms of the specific solution?

Few of us will be able to answer these questions; indeed, you may consider them to be a little silly. You may ask, "What difference does it make to us how we solved the problem; isn't it enough to have solved it without trying to describe the mental processes involved?"

Mr. Kogan, who discusses these questions in these pages, thinks not. He feels that it will be of great help to us if we know something about the way we attack difficult problems and effect their solution. More than that, he feels that a method can be devised whereby we can approach specific problems from a generalized standpoint and thus bring about the solution in an orderly sort of way. As he says in his article, what he was looking for was the *something* that makes it possible for men of great responsibility to come up with solutions as magicians pull rabbits out of hats.

Now, to understand Mr. Kogan's thinking, one should know something of his professional career. Zuce Kogan is a Chicago consulting engineer. He came to this country some 30 years ago, a young man, with a good grounding in the principles of combustion, but with little knowledge of the language, and with no friends or acquaintances to help him get started. Nevertheless, he set himself up as a consulting combustion engineer and proceeded to apply his knowledge on the basis of what savings he could make for his clients. No savings, no pay.

Those who read Mr. Kogan's article, "Meeting Technological and Economic Changes" in the September 1950 issue of POWER ENGINEERING, will know how successful he has been during his quarter of a century of practice in the consulting engineering field. During the years, he has successfully solved hundreds of difficult problems—problems that had baffled other good engineers. His activities spread far beyond the field of combustion, but always he has been able to effect improvements resulting in savings and increased reliability. His uncanny insight into unusual industrial problems and his ability to solve them has given him a national reputation. With his keen analytical ability it is quite understandable that his main hobby, if it can be called a hobby, is chess. — AWK

IN AN ARTICLE, Meeting Technological and Economic Changes, published in these pages [1] some time ago, I described in detail some of the problems I had met and solved in the course of 25 years of consulting practice. These experiences were received favorably but some who read them suggested that such studies would be of greater value if they could point out what, essentially, helped bring my cases to a successful conclusion. This sounded like a good idea, and soon I began my search for this *essential*.

In my work I had come to realize that knowledge, imagination, concentration, memory, intuition, etc., were all necessary or helpful in solving problems, but that it was not merely a matter of saying that one or another of these was essential. What I was looking for was the *something* that made it possible for men of great responsibility to come up with solutions as magicians pull rabbits out of hats. I liked that. If only I could explain it.

I had read much about the intuition of great geniuses. There was the story of Karl Freidrich Gauss, who in grammar school, was asked, along with the rest of the class, to add the figures from 1 through 9. He thought a little, and almost immediately said, "I know the answer." The other children had not had time to add the first three digits while Gauss already had the sum. How did he do it? Was it intuition or was it a method — a method that might be used in solving other problems?

Lucky Guesses or What?

In thinking over my own experiences in hunting down the solutions to problems, in conferences with engineers of more experience and more extensive education than I had, I had often come up with quick solutions of amazing accuracy. Were they merely lucky guesses or was I unconsciously using a method of some sort?

About this time I happened to be attempting to increase the efficiency of a boiler, a task that seemed to resolve itself into the impossible job of making a damper that would leak and would not leak at the same time. Each time I attempted to solve this problem I had failed miserably. Until I recognized (similarity) the problem to be of the following type:

"The damper must leak (to provide a safety outlet to prevent an explosion), but the damper should not leak (because leakage reduces the efficiency of the boiler). The problem, therefore, is similar to having to take a medicine that is good for one disease (say heart disease) but also produces harmful effects (say stomach trouble)."

It then dawned upon me that the general procedure in tackling such a problem should be to counteract, in some way, the harmful effects while retaining the good ones. This general procedure defined itself into the principle, *if a necessary function also has bad effects which cannot be eliminated, add something to counteract the bad effects.* Applying this to the foregoing example, the answer would be to take an additional medicine which would prevent or relieve the stomach trouble.

I need not elaborate on how I applied this principle to the damper problem, since this would require going into complex technical details. I only want to emphasize that once I had conceived this principle, and used it with success, I realized that I had learned something I could use in solving other problems.

It seems then, that when stumped by a difficult problem, the first task is to find a principle which applies. The problem thus consists of at least two steps — to find the principle, and then, using this principle, to find the solution.

Now, it is probably true, that experienced engineers and executives in responsible positions, who pull solutions out of hats unconsciously

Like pulling rabbits out of a hat

* All rights reserved by the author.

[1] September 1950 issue.

do it in this way, indeed, my further study indicates that they do. But where do these general principles come from? What, in any particular case, makes us think of a certain approach rather than another, and where are they learned in the first place? By studying various accomplishments, one realizes that approaches stem from seeing the problem in its general characteristics.

The Oil and Steam Problem

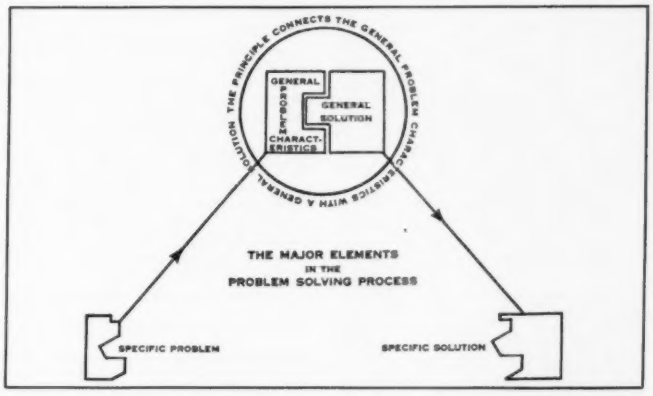
Let us consider an actual example. In a recent case I was confronted with the problem of removing finely divided oil from steam, a problem that had stumped other engineers working on it. Ordinarily, the oil particles could be separated by means of a centrifuge but in this case the particles of oil were so small that centrifugal force would not do the job.

So I asked myself the simple question, "What are the general characteristics of the problem?" First, I saw that there were tiny particles, regardless of whether they were oil, dust, or other foreign matter. Second, that these particles were floating or were attached to a gas. Third, that the problem was to detach or separate the particles from the gas. Fourth, I realized that the removal process must be low in cost.

When considered in this light, an approach suggested itself. This was to *detach*, and *attach* to another substance. An example of this approach is the familiar procedure of removing lint from a suit (detaching it) by using scotch tape (attaching it to the tape). But *why* did this approach suggest itself? In thinking it over, I had realized that I was familiar with another problem of the same general characteristics, namely, the problem that the gas industry faces in cleaning gases of dust. To do this, the gas industry had used scrubbers in which dust particles are attached to water in the form of a spray. They are thus detached from the gas. As matters progressed, I found I was able not only to get my approach from this comparable problem but also my solution, for it turned out that a gas scrubber similar to those already used in the gas industry did the job of removing the oil particles efficiently.

The important point of this is, that as long as I considered the problem as dealing with *oil* and *steam* as such, instead of with small particles and a gas, no similar or comparable problem suggested itself. Indeed, in the end the gas scrubber manufacturers themselves expressed their appreciation, for I had shown them a new use for their machine.

Now, consider another example. All of us know that when cutting soft cheese with a knife the cheese accumulates on the knife and makes continuous slicing difficult if not impossible. It is perfectly obvious that if we could eliminate the blade of the knife, the trouble would disappear.


SOLUTION THE PRINCIPLE CONNECTS THE GENERAL PROBLEM CHARACTERISTICS WITH A GENERAL
GENERAL PROBLEM CHARACTERISTICS
GENERAL SOLUTION
THE MAJOR ELEMENTS IN THE PROBLEM SOLVING PROCESS
SPECIFIC PROBLEM
SPECIFIC SOLUTION

Major elements in problem solving

But we need the cutting edge! Can we eliminate the blade and retain only the cutting edge? Yes, and when we do that we have the familiar wire cheese cutter! Here we found the blade unimportant and so eliminated it. In this case, the cheese and the knife, as such, are unimportant but it enables us to arrive at a solution. Something is unnecessary. It gives trouble. With an understanding of these characteristics we arrive at the principle: *if something is unnecessary and gives trouble, remove it.*

From this line of reasoning I was

The damper should leak and not leak!!!

able to conclude that the answer to the question, "What is the essential in problem solving?" could be expressed in the following way: *if you do not have a specific solution to a specific problem, then generalize the problem* (in terms of problem characteristics) and attempt to find or match it with a general solution (principle or approach). The accompanying diagram is an attempt to portray the major elements in the problem solving process. For one who already has a large supply of general principles and approaches, this formulation may be further simplified to: *recognize the general problem characteristics and choose the best approach.*

Factors Influencing the Essential

The next question that bothered me was, "What else does this process of problem solving include?" When an executive, for example, tackles a production problem with the approach, *fully utilize the existing machines before purchasing new ones*, he may do so either because the approach has become common knowledge to him through past experience, or because he thinks it out — the hard way. These two methods, however, do not explain all the factors that go into forming, choosing, and using an approach. In many instances, in my experience as a consulting engineer, I have submitted detailed reports on a comparative study, only to have two or more engineers each come to different conclusions as to the best solution. In such cases the engineers obviously had different approaches. Why? Because they were individuals and, as such, each had different experiences leading to their own characteristic ways of looking at a problem.

A good example of the influence of a personal factor is had in Dr. Irving Langmuir's work in developing the gas filled incandescent lamp. At that time, it may be recalled, metallic filament lamps were subject to serious blackening of the glass interiors or the bulbs. It was thought that this could be prevented by the attainment of higher degrees of vacuum and for a long time Langmuir worked on this problem — that of producing better vacuums. Here he met with disappointment, no matter how refined his vacuums, there still remained traces of gas and the bulbs continued to darken. When he could not remove any more gases, but wanted to know what would happen if he could, he deliberately introduced an inert gas into the bulb, and, Lo, that was the answer. The pressure of the gas in the tube prevented rapid

evaporation of the tungsten filament. There were other considerations, of course, but this, essentially, is what solved the problem. Now, in this case, Langmuir used a principle which in subsequent years he says he often found equally useful. This can be summarized briefly as follows: to find the effects of removal when actual removal is difficult, add more. (The opposite approach.)

So much for Langmuir's solution. I do not presume to know of a better solution than the one Langmuir actually found but Langmuir was a chemist and it would be interesting to know how a person with different technical training and experience might have tackled the problem. An experienced metallurgist would probably have tried to develop some alloy that would not evaporate at high temperatures.

Scope Factors

Whenever we have a problem, it may be considered in a narrower or wider *scope* depending on what we want to include in our problem. In the Oil-in Steam problem, for example, it was necessary to consider the cost of whatever apparatus was needed for removal. This imposed certain limiting considerations. In some classes of problems, problems having to do with military equipment for example, cost may not be important but usually it is.

Scope factors can be divided into two classes, though the dividing line between the classes may be hazy. For purposes of definition, however, one class can be called the *minimum* or *assumed* factors, and the other the *look further* factors. The minimum scope includes such factors that we assume or take for granted. For instance, I never would consider a solution unless it included reasonable provisions for safety, fire protection, health of worker, etc. The cost factor, also, is usually assumed.

The look-further factors are those that widen the problem to a scope of more than the absolute minimum requirements. For example, in considering the problem of ending the war, if my approach includes an educational campaign against further wars, then I am looking further than the absolute minimum of signing an armistice.

A classic example of the look-further scope is had in Newton's formulation of the laws of motion. Newton's solutions in this field did not include speeds that are very high, anywhere the speed of light. As a consequence, Newton's laws, while adequate for the purposes for which they were formulated, could not account for the behavior of bodies such as electrons traveling at practically the speed of light. Dr. Einstein, however, did incorporate very high speeds in his theories, thereby enabling him to account for phenomena completely beyond the scope of Newton's laws. This is what we mean when we say that there is no perfect solution in science. In other words, the problem is fluid, depending on its scope.

The great cheese knife problem

The Fluid Solution

There is no such thing as having *the solution* to any specific problem. What we get is *a* solution. We can always use a number of approaches, each approach leading to a number of possible solutions. In my own experience, when I receive an assignment, I develop one or more solutions, think them over, and gather more ideas. Finally, time considerations and the financial elements bring me to a halt. I, therefore, decide at a certain stage after my minimum standard has been attained, that on a certain hour of a certain day I will do no more work on this problem, but will present the solution I have reached. If I do not weaken, but stick to my decision, I know I will have at least one good solution, and that further improvement is limited only by these outside factors.

Processing the Problem

Now, just how does one go about using methods such as these in solving an actual problem? This, obviously is not easy to explain and what I say here constitutes only a picture of the mental processes as I see them. Let us assume, however, that our brain has two major compartments, one, the *ordinary thinking* compartment and the other the *creative thinking* compartment. When we encounter the problem, "separate oil from steam," we send it to the ordinary thinking compartment for a specific solution. In this compartment it meets a wall called *memory*. We find that none of the memory matter recognizes a similar experience, and the problem comes back, "impossible to solve."

So we send the problem to the creative thinking compartment. We find that this is a complex and highly organized affair consisting in effect of a series of jigs representing the various scope factors previously discussed. Here parts of the problem become generalized; the steam becomes a gaseous substance, the oil particles, specks of matter. The key to the total problem reads, "Separate specks of matter from a gas" (not oil from steam). In this compartment there is a memory section in which are stored solutions to similar problems. Suppose we find one which has been successfully solved by using the principle, *to detach, attach to another substance*. It seems to apply to the problem in hand so we decide to use this principle. In its generalized state the problem is applied to the various jigs, jigs representing physical or chemical action, jigs involving absorption, filtering, scrubbing, etc. In this way a solution may or may not be arrived at. If no solution is obtained, it may be sent back to the memory section where another principle may be tried.

Take the case of the cheese knife, for example. In our previous discussion of the cheese knife problem we considered only one principle, *if something is unnecessary and gives*

THIS article on problem solving is based on Mr. Kogan's book, "Essentials of Problem Solving" published last year. We feel that this discussion should be of particular interest to practical engineers because it is part of the practical engineer's everyday job to solve problems of one type or another. As has been frequently pointed out in these columns, the practical engineer has to be an ingenious fellow; often he has to make changes or repairs under trying circumstances; often too, as in the sudden loss of load or loss of steam pressure, he has to think fast, and act fast. While Mr. Kogan's discussion may sound somewhat cumbersome to those who have not acquired the knack of generalizations, it will help them to think fast and act fast once they have acquired it. In presenting this article, neither the editors nor Mr. Kogan assume that it is comprehensive. Only a few principles are indicated. To be generally useful it will be necessary to develop as many general principles as possible. One way to developing such principles would be to make systematic studies of the work of the world's great men for from them we can glean the strikingly simple examples that helped make possible great accomplishments. Discussion and comments on the subject from readers will be welcomed.

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trouble, remove it. It gave us one solution but there probably are others. Let us apply this problem to several of the principles we have considered:

1. *If something is unnecessary and gives trouble, remove it.* (This leads to a general solution of removing all or part of the blade.)
2. *To detach, attach to another substance.* (The general solution here would be to attach the cheese to something else beside the blade, possibly to itself by making stronger textured cheese.)
3. *If a necessary function also has bad effects that cannot be eliminated, add something to counteract the bad effects.* (Thus, the adhering effect of either the blade or the cheese could in some way be counteracted. For instance, wax paper wrapped around the blade would do the job.)

Thus we see that there are a number of solutions to each problem. Which one we finally choose depends upon the specific problem. For example, some years ago in a large plant where CO_2 was a by-product, dry ice was compressed into large cubical cakes in a hydraulic press. Great trouble was experienced by the cakes sticking to the plunger platform after they had been formed. After months of futile experimentation, one day, the operator of the press got an idea. Before the CO_2 snow was injected into the press, he placed a sheet of paper on the platform. When the cake was formed, the paper adhered to the ice and the block slid off the platform easily.

It will be apparent that this problem was similar to the cheese knife problem but its successful solution lay in the application of principle 3, *if a necessary function also has bad effects that cannot be eliminated, add something to counteract the bad effect.* The paper was added.

Just why the operator thought of the paper, I do not know, but I feel reasonably certain that if the problem had been generalized in the manner suggested here, a great many of those months of futile experimentation might have been eliminated.

Value of an Approach

Just how far we can go in developing methods such as these in the solution of our problems I do not presume to know, but even this brief discussion of the subject shows the value of the generalized approach. The value of the generalized approach lies in the fact that it is a general path leading to many possible solutions. An approach once learned becomes applicable knowledge. Knowledge of an approach does not necessarily imply knowing the details involved in reaching a particular solution. For instance the successful executive, the head of a research department, or anyone else who guides and plans, may suggest an approach to a problem which would decide the general direction

Young Gauss knew the answer quick

or procedure without being concerned with, or knowing the details involved. (The man who takes over the problems even though he may make use of the approach suggested by the executive, will however, have to start with a new general principle if he cannot think of a specific solution to further the work.)

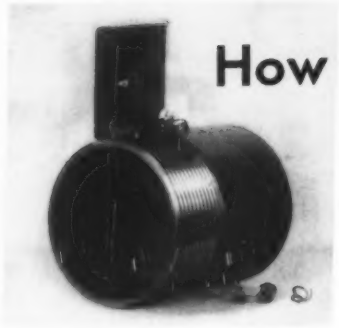
Thinking processes are, of course, extremely complicated and in suggesting that there are rigorous methods by means of which we can attack problems, I do not imply that we can all become Gausses capable of solving complex mathematical problems instantly as Gauss did. There is no question that Gauss was a brilliant man but he could not have become the great mathematician he was, unless he had developed certain approaches to handling problems. How Gauss added the digits, 1 to 9 so rapidly we can only surmise. He might have added the figures as they appeared, in succession, as you and I would have done. But to account for the speed of his addition we can assume that he used some other, quicker mental process. He might possibly have seen the figures in a group of tens, that is 1 plus 9, 2 plus 8, 3 plus 7 and 4 plus 6, adding the extra 5, thus thinking "4 x 10 plus 5 equals 45."

Chances are that Gauss used the grouping approach just as Langmuir used the opposite approach to solve his problems, and just as all great thinkers use a generalization or approach to guide them in solving quickly and efficiently their problems.

In east Texas oil wells, a thermosetting plastic has been used for bottom hole plugging and for shutting off higher zones of gas and water. The liquid plastic is introduced at surface temperatures. It penetrates the permeable formation easily and is not diluted by water or oil. The natural earth heat and pressure caused by a controlled water column sets the plastic in 2 to 12 hours. The plug can be penetrated by a drill bit if necessary.

Protective Headgear for Linemen

Working below line poles or in underground vaults, linemen of the Consumers Power Company of Jackson, Michigan, wear protective headgear to avoid injuries from falling objects. Part of the company's extensive safety program, the protective hats also are designed to protect against electric shock. Note that these linemen are equipped with rubber sleeves and gloves as they set a pole near an energized circuit. New poles often contain moisture and become energized if they accidentally contact the line.



How to Thread Pipe RIGHT

Good pipe threading produces strong leakproof joints . . . Use good equipment . . . What is a good thread? . . . How to make a good joint, and tighten pipe properly . . . Types of dies . . . How to thread . . . Good and bad dies . . . Which die for which pipe . . . Die maintenance . . . Causes of poor threads . . . Here is some handy pipe dope that'll help you

By JOHN FOSTER

THE PURPOSE OF THREADING PIPE is to produce strong, leakproof joints wherever joints are necessary. It is impossible to accomplish this purpose, however, unless certain precautions are taken. Failure to take these precautions simply means that valuable time will be wasted in trying to overcome defects that could have been eliminated in the first place.

Use Good Equipment

The first requirement for cutting satisfactory pipe threads is good threading equipment. This means well designed and constructed threading tools, kept sharp and properly adjusted. Losses in time and materials occasioned by the use of poor quality or worn out threading tools can exceed the cost of good replacement tools.

However, other factors enter into the matter of cutting good threads. Thus it is possible that thread defects may be corrected either by eliminating tool defects or by correcting mistakes in threading procedure, thus making the purchase of new threading equipment unnecessary.

What Is A Good Thread?

As shown in Figure 1, American Standard Taper Pipe Threads follow a definite formula, designed to provide tight joints when correctly adhered to, and arranged to allow for ordinary degrees of variation in depth of thread.

To insure tight joints, however, it is necessary that the threads cut be correct in taper, thread angle, lead and diameter, and that they be smooth and uniform. The allowance for cutting tolerances takes care of reasonable variations in threading equipment. As shown in Figure 1, when properly cut, the thread dimensions permit sufficient hand engagement, and allow enough additional threads for wrench make-up.

When threads are cut to proper dimensions, slight defects such as partial flattening of some of the threads or gouging out of some of the thread metal should not prevent the making up of a tight joint, hence such pipe should not be discarded as being defective. It should be realized that a very small amount of perfect thread is sufficient to produce a tight joint.

Correct thread length is a factor in producing tight joints, since insufficient length will not provide enough thread taper to permit tight thread contact; on the other hand, excessive length increases the friction produced when tightening the joint, thus preventing close contact between the metal of the engaging threads and hence producing a loose joint.

Figure 2 gives the normal thread engagement required to produce a tight joint for various sizes of pipe. These dimensions are based on practical working conditions and apply only where ordinary threaded fittings are used. The use of threaded companion flanges requires a thread length determined by the flange weight, pressure and type of thread joint employed, hence the information given in Figure 2 does not apply to such fittings.

How To Make Good Joint

When making up a threaded pipe joint, it is important that the threads of both the pipe and the fitting be thoroughly clean. Any burred or bent threads should be straightened or removed. Next apply a uniform coat of thread compound possessing good lubricating qualities to the pipe threads only, not those of the fitting. It is very important that only a lubricating type thread compound be used, because the lubricant reduces friction between the thread surfaces and thus permits the two parts to be pulled up further, resulting in a tighter pipe joint. This is especially important in the case of stainless steel pipe and fittings, as this type of metal is extremely ductile and the threads have a tendency to seize and gall when tightened.

How To Tighten Pipe Joints

In tightening pipe joints, avoid threading them together too rapidly, as this will cause heating and expansion of the metal parts and may result in a loose joint when the parts cool.

When threading pipe, be sure to ream out any burrs left on the inside by the pipe cutter. This is very important as a badly burred pipe may actually be reduced in carrying capacity to that of the next smaller size.

Also remove any burr on the outside of the end of the pipe with a file, being sure to level the entire circumference so that the dies will start easily.

Types of Dies

There are many types of pipe threading stocks and a number of types of power threaders. When selecting such tools it is well to learn all the favorable and unfavorable features of each type so as to be able to decide which should be chosen, from the standpoint of utility and cost.

Hand threading stocks are made in plain and ratchet styles and employ several types of dies. Solid dies consist of solid metal blocks having threads cut in the center. They cannot be adjusted; nor can they be readily sharpened by ordinary means.

Sectional dies consist of removable pieces or sections. These can be sharpened on a suitable grinding wheel, but they are non-adjustable.

Adjustable dies are arranged both for removal for sharpening and for adjustment to cut standard depth or undersize or oversize threads. The latter feature permits the cutting of suitable depth of pipe threads to match the actual depth of threads in fittings with which the pipe is to be used. This is desirable at times in order to insure tight joints, since commercial pipe fittings vary as much as plus or minus 2 to 3 turns.

Expanding dies are used in threading stocks arranged to permit the dies to be moved closer together or farther apart, usually by means of cams. This permits one die head to thread all sizes of pipe having the same number of threads; for example, ½ inch and ¾ inch (14 threads) and 1 inch, 1¼

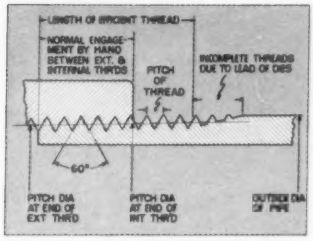

LENGTH OF EFFICIENT THREAD
NORMAL ENGAGEMENT BY HAND BETWEEN EXT. & INTERNAL THRDS
PITCH OF THREAD
INCOMPLETE THREADS DUE TO LEAD OF DIES
60°
PITCH DIA AT END OF EXT THRD
PITCH DIA AT END OF INT THRD
OUTSIDE DIA OF PIPE

Fig. 1. Cross-section showing American Standard Taper pipe threads

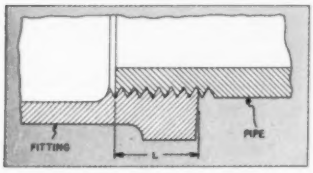


Fig. 2. Normal engagement between inside and outside threads to provide tight joints

SIZE	⅛	¼	⅜	½	¾	1	1¼	1½	2
L	¼	⅜	⅜	½	⅝	11/16	1 1/16	1 1/16	⅝

SIZE	2½	3	3½	4	5	6	8	10	12
L	1 5/16	1	1 1/16	1⅛	1¼	1 5/16	1 7/16	1⅝	1¾

inch, 1½ inch and 2 inch (11½ threads).

Receding dies are employed in threading stocks having a mechanism that gradually moves the dies farther apart as the threading progresses. At the beginning the dies cut a full depth of thread, but the thread gradually becomes shallower until, after it is completed, the dies leave the pipe surface and the stock can be slipped straight off the pipe.

How To Thread

Before threading pipe, it is well to try each fitting or valve on a section of pipe having standard depth threads to determine whether the pipe end to be threaded should have regular depth or oversize or undersize threads to match.

Generally it is better to start the threading dies on the pipe before applying oil, unless the pipe is small. If the dies fail to take hold apply chalk to the end of the pipe, but be sure the outside of the pipe is free from burrs or swelling left by the pipe cutter, since this may be the cause of the difficulty.

When starting the thread, and while threading, be careful to pull the stock handles through one plane, otherwise the twisting of the dies will chew away the pipe metal and may damage the threads of both the die and the pipe.

If chips fail to leave the dies as they form, remove them before they pack and tear the thread, using a stiff brush or pointed stick for the purpose. If possible, avoid backing the dies until the thread is completed.

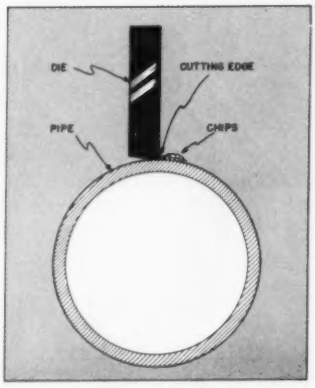


Fig. 3. Example of poor die design. Die at this angle pushes the metal from the pipe because it does not have a cutting edge

Fig. 3a. Photo of condition illustrated in Fig. 3

From time to time, apply a good grade of threading lubricant liberally to the dies and thread being cut. This is important as it will help insure clean, sharp threads, reduce the effort required to turn the dies, and will minimize heating of both the dies and pipe with consequent chance of inaccuracy. Lard or lard oil may be used, but a quality grade of sulphurated threading oil will prove very satisfactory, the sulphur content giving it high heat absorbing properties. It is advisable to use only oil that is antiseptic and harmless to the skin.

Where receding dies are employed, the thread length is automatically controlled, as the dies stop cutting when the proper thread length is reached. However, on some types of such threaders the cutting of undersize thread will cause the thread length to be too short, while an oversize thread will be too long. When regular full width dies are used, the thread is proper length when the end of the pipe comes flush with the outside face of the dies.

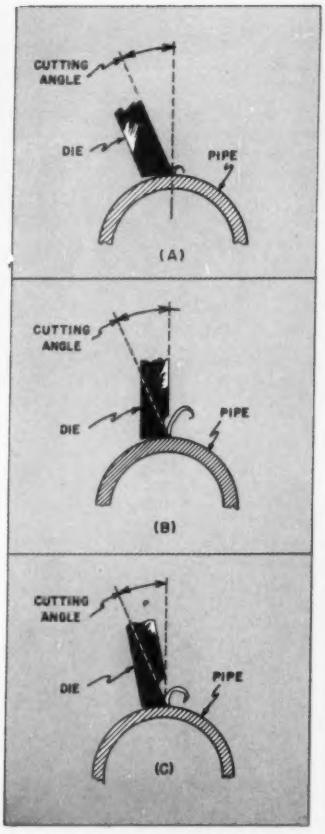


Fig. 4. Examples of ways of obtaining the cutting edge of a properly shaped die

Care is necessary in backing off or removing the dies from the finished thread to avoid stripping or damaging it.

Good and Bad Dies

However, it is impossible to cut good threads unless the threading equipment is of good design and in good condition. Some dies, for example, are unable to cut a satisfactory thread, even when new, because of their design or the design of the die stock, as shown in Figure 3. Such a die merely pushes the metal from the surface of the pipe since it does not possess a cutting edge.

As shown in Figure 4, the cutting edge of a properly shaped die may be obtained in several ways. At (a) is shown a die similar to the one shown in Figure 3, but set at an angle to the surface of the pipe. The cutting edge angle of this die is the angle between the face of the die and a line perpendicular to the pipe surface.

The die shown at (b) in Figure 4 is set perpendicular to the pipe surface, similar to the position of the die shown in Figure 3, but a lip has been

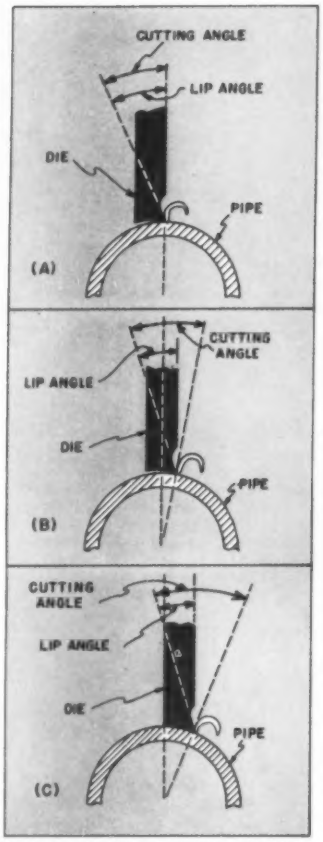


Fig. 5. Example showing how cutting angle of the die is also affected by its position in the stock or head

ground into its leading surface to produce a cutting edge, the angle of which is the angle between the surface of the lip and the leading surface of the die.

At (c) in Figure 4 is shown a die combining a lip and an angle setting. The angle of the cutting edge of this die corresponds to the angle between the surface of the lip and a line perpendicular to the pipe surface. The cutting angle is thus obtained with a lip angle less than that of the die shown at (b) in the same figure.

As shown in Figure 5, the cutting angle of the die is also affected by its position in the stock or head. At (a) the die is set with its cutting edge on the center line of the pipe; at (b) it is set slightly ahead of the center line; and at (c) it is set far enough ahead that the heel is in line with the pipe center line. In each example, the cutting angle of the die is the same but the lip angle of the die is different.

Which Die For Which Pipe

The type of pipe being threaded has a considerable influence on die

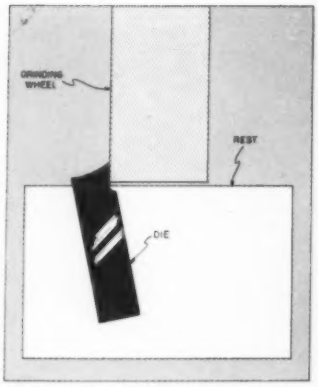


Fig. 6. Correct method of resharpening threading die

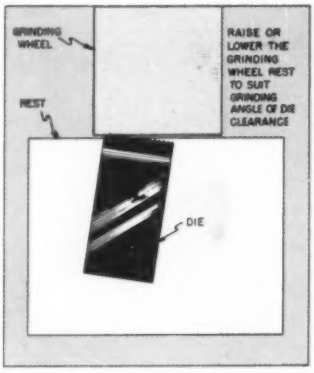


Fig. 7. Method of regrinding die to compensate for wear

cutting angles and other factors. For ordinary steel pipe the cutting angle should be between 15 and 20 degrees. This angle is also suitable for threading higher carbon or alloy pipe. But where soft open-hearth or deoxidized Bessemer steel pipe is to be threaded the cutting angle should be increased to at least 25 degrees.

Stainless steel pipe, being generally tougher than mild steel pipe, requires a die cutting angle of 22 to 25 degrees, and the dies should be made of high-speed steel, not carbon steel. It is essential that the dies be kept sharp, otherwise they will break down rapidly as the cutting edges begin to dull, and the pipe surface will be roughened and torn. The dies should have long leads of about 3 or 4 threads, and sufficient space should be provided to permit ejection of chips.

For machine threading a cutting speed of 10 to 12 feet per minute is recommended. This is considerably slower than for mild steel pipe. Since the power required to thread stainless steel is approximately twice that needed for carbon steel, it is essential that the pipe be gripped sufficiently well to prevent slipping. Sulphurized

Fig. 7a. Photo of condition illustrated in Fig. 7

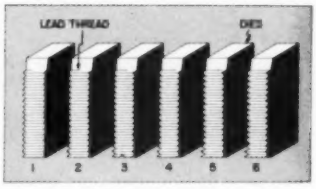


Fig. 8. Example of set of dies properly ground in sequence. Note the lead thread progresses from one die to the other throughout the set. Example of good threading

threading oil is recommended for this.

Whenever possible, hand threading of stainless steel pipe should be avoided. But where necessary, the same procedure should be followed as for machine threading.

Where the cutting angle of the threading dies is not correct for the material being threaded, the threads produced may be crooked or wavy. Additional power is also required and this may break out die teeth, resulting in jamming of chips and causing tearing of the tops from the threads and additional friction. Unless a toolmaker is available to properly alter the cutting angle of such dies, they should be returned to the manufacturer for correction.

Die Maintenance

When threading dies become dull, they may be resharpened by carefully regrinding the lip. As shown in Figure 6, small hand stock dies can usually be ground on the corner of a grinding wheel. However machine dies can be ground properly only on a surface grinder. But in either case, grinding should be uniform across the full face of the die and the least amount of metal necessary should be removed. It is important to grind each die in turn in the sequence it occupies in the stock or head, and an equal amount of metal should be removed from each.

The original lip contour must be followed to avoid ridges or corners that will prevent easy curling of chips.

In grinding threading dies, grind only a little at a time, to prevent overheating of the metal and drawing of the temper.

Dies may be reground, as shown in Figure 7, to compensate for lead wear. As shown, the die must be held exactly horizontal and not allowed to shift on the rest, otherwise the cutting edge may become rounded. Carefully follow the original lead shape and angle, removing only the least amount of metal necessary.

The dies should be ground in the sequence they occupy in the stock or head. To obtain the correct grinding position, grind the first die lightly, then examine it. If the ground area does not cover the entire surface requiring grinding, change the angle of grinding or the height of the wheel rest, or both, if necessary, until the proper arrangement is found to produce correct results. In this way, grind each die exactly the same amount, even though one or more may be duller than the rest, the dullest die governing the amount to be removed from each of the dies.

When a set of dies has been properly ground in sequence, their appearance will be like those shown in Figure 8, in which the lead thread progresses from one die to the other throughout the set.

Broken teeth should be removed from dies to prevent their jamming chips and consequently tearing the thread tops. This may be done by grinding them out down to the thread root, using a thin grinding wheel. Avoid grinding away the lip.

Where the threads of dies become dull they often produce rough or ragged threads. Such dies should be returned to the manufacturer for resharpening.

Even though threading dies are properly designed and sharp, care is necessary to see that all factors are correct, if good threads are to be produced. Dies should be carefully checked to see that their identification numbers are alike (identifying them as belonging to the same set), that they are placed in the stock or head correctly according to their sequence numbers, that they are held rigidly in position and thus assure proper cutting angle and thread clearance, and that adequate chip clearance space is provided in front of each, or that they project at least ¾ inch beyond the die ring for the same purpose.

The maximum depth of thread of opposite dies in a stock or head should never be less than the outside diameter of the pipe, as thread tearing, overheating and damage to the dies will result.

Dies must be properly centered and adequately tightened in the stock, when hand threading, to avoid wavy threads. Such thread defects may also be caused by worn starting threads on the dies, or by chips in the die slots, or because the pipe end has not been cut off square.

Wavy threads, when machine threading, may be due to a worn die cam or to wear of the die slots.

In both hand and machine threading, chewed or rough threads can be caused by dull dies, chips between the die and wedge, wrongly ground lead, excessive lip angle, a broken die tooth, or insufficient supply of proper threading lubricant.

Shaved threads are caused by dies being out of line, generally due to chips or dirt in the die slot. But in machine threading it may be caused by dragging of the die carriage.

Sometimes when using receding type dies the threads produced will be straight instead of tapered. This can be caused either by stuck dies, dies wedged by chips, or excessive lip angle.

Shoulders on threads cut by hand are caused by diagonal starting of the threads, due to failure to cut the pipe end square. In the case of machine threading, it is likely to be due to the dies and chuck being out of alignment.

Herman and The Lady Wrestler

An episode of Oscar, the Gas Work's Owl. "u cant beat peepl hoo wont b beat" says Oscar after the great anticlimax to this story of somebody who wouldn't

By JOHN RAVEN

ONE MORNING the Boss greeted me thusly, with more anger than pain in his window-shaking accents:

"John," he bellowed, "why haven't you put up the notices about the President giving a citation tonight to Herman the Hero? Don't you care about employee relations? Must I do everything myself in this confounded gas works?"

Since this was the first I had heard about any citation for Herman the Hero, I knew right away the Boss had forgotten to tell me and now was forgetting most conveniently that he had forgotten. In short, I was to be the goat man, as usual. While I was thinking up a good hot retort, the telephone rang, and from the sudden honey in his voice, I knew the Boss was talking to an outsider.

"Yes, that's right, sir," he purred like a boiler getting good make-up water. "The ceremony is at 8 tonight. What did Herman do? Well he ran his yard locomotive right into the flames that were shooting out of a burning oil storage building, and he kept it there to act as protection for an injured man who had crawled across the tracks on his hands and knees and then collapsed. Except for Herman's heroism, the man would have burned to death where he lay. Herman got singed a bit himself. Well, see you tonight sir. Glad to have you."

He hung up the receiver and pointed a big fat finger at me across his desk.

"That," he said, "was the newspaper. You see now what a situation your oversight has caused? Suppose nobody came to the ceremony? What would the President say? What would Herman think? What would the papers print?" He thumped the desk until his inkwell shuddered. "John, you listen to me, and good. Either you'll get a notice on every bulletin board in every building before noon today, or I'll advertise for a new engineer in tonight's papers. Is that clear in your weak mind?"

"Yes sir, yes sir," I admitted tactfully while I peeped at the office clock and wondered how I could have notices made and posted in three hours.

"And what's more," he bellowed as an afterthought, "that damned office cat's been dragging dead rats in here for me to see. Make her stop it."

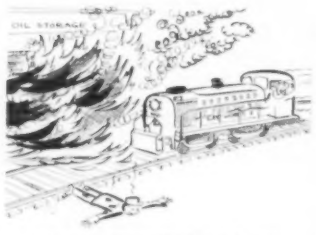
"Yes sir, I'll speak to her," I assured him, then got out as fast as I could before he thought up something else to yell about. The only reason he didn't chase the cat himself was because he was afraid she would scratch him, the big baby.

As though I didn't have enough trouble already, when I got to my office, there was Herman the Hero himself, sitting beside my desk and

looking very sad. In fact his face is just naturally so long and sad looking that everybody used to call him Herman the Horse before he became a hero. Now his expression said clearly without words that being a hero was even sadder than being a horse.

When he saw me he scrootched his greasy dungarees around in my best chair, and from his five feet two of 110 sorrowful pounds came these lugubrious words:

"John, I bin around these gas works, man and boy, fer 25 years. Workin' here is like bein' at home. But John, since I bin a hero it ain't the same. People is tryin' to run my life fer me which didn't know I was alive before. In fact, one lady is makin' them weddin' bell eyes at me so determined, that if stay around here she'll get me sure. So John, I'm quittin'. And I'm leavin' town this afternoon. I just gotta. You see? Bein' a hero ain't no cinch."



Ran his yard locomotive into the flames

A runaway tear galloped down his long horse's face, and it was more than matched by the sweat that started down mine as I thought of what the Boss would say if Herman walked out now. I'd better walk out right beside him, or maybe to be safe, a little ahead of him.

"Herman," I cried aghast, "you can't do this to me. What will the President say? What will the papers print? And think of your locomotive, with a stranger at the throttle after 20 years. Herman, who is this lady? I'll have her fired."

Herman the Hero swallowed a sob. He dropped his sorrowful head wearily, like a cart-horse after a long day on cobblestones.

"John," he stated mournfully, "it ain't safe to mess with this lady. Yesterday she caught me unexpectedly and gimme a hug that like to bust three of my ribs. Nope, I gotta go."

He stood up then and stuck out a calloused hand.

"Good bye forever, John."

I ignored the hand and hustled myself between Herman and the door.

"Herman, listen. Give me a chance. How do you know I can't think of something? What's this lady's name?"

He considered me a minute, uncertainly, but without hope.

"Well," he said reluctantly. "She is a lady which works in the cafeteria and at night wrestles in the light-heavyweight class. Her wrestling name is Little Lollipop on account of her wearing lace trimmings on her tights, which she thinks makes her look like one. Now you see why you can't do nothin'?"

I saw, all right. The Boss would sooner burn down the gas works than fire Little Lollipop, because every time she wrestled the newspapers commended on how good our cafeteria must be to produce an alumnus nourished like Little Lollipop. She was the gas works' best publicity.

"Herman," I admitted, "this is indeed a shock. But wait. Let me think."

I went back to my desk, and while Herman watched hopelessly, dug out my private notebook in which I record for posterity, but mostly for myself, the sayings of Oscar the Gas Works Owl. The first gem of wisdom I read was this:

njuneers home life (said Oscar) needs as much careful maintenans as any powr plant and the best maintenans is 2 giv ur wife something she wants once in a whil insted of cranky words or a insult bcaws u r mad at a turbin or blu a tube or got hel from th boss

While I was deciding there was no help in that particular bit of advice, the Boss commenced bellowing for me in a way that shook the building. It sounded as though murder had happened at least, but all I found was a dead rat, its throat chewed through, lying beside his chair. There was no sign of the cat.

"One more rat in my office," yelled the Boss, pointing his fat finger at my nose, "and you're fired! Didn't I tell you to do something about that cat? Can't you understand English?"

"Yes sir, yes sir," I said hastily picking up the rat by its tail.

"And where are the notices of the citation ceremony?" he added at full voice. "Are they being put up, as I told you?"

"Boss," I said soothingly, although my knees were quaking over the true state of affairs, "stop worrying. Everything is going to be O.K."

"It better be O.K." he yelled after me as I backed out of his office.

Herman the Hero was awaiting my return with some interest.

"Tsk, tsk," he said, "such yellin'. What's wrong with the Big Bushwah? And what're you doin' with the dead rat?"

I looked from Herman's sad but curious face to the forgotten rat, and

There was Herman the Hero himself sitting in my chair

suddenly I saw a way out. It was as simple as this: if an insult in the home could alienate a wife, as Oscar said, why wouldn't a public insult given to Little Lollipop, who wasn't even a wife, practically demolish her?

"Herman," I said solemnly, "because of this rat your troubles are over. We will call on Little Lollipop in the cafeteria at 12 noon when everybody is there, and when we are finished with Little Lollipop, she will never cast her shadow over you again."

Then her big arms reached out like forked lightning

"Well," said Herman doubtfully, "Amen. But if it don't work, I'm runnin' John, and quick. I ain't takin' no more chances."

I felt so sure my insult would work that I called the paint shop and ordered the notices made up and posted. I even talked like the Boss when they said it couldn't be done.

"Do it or get fired," I yelled into the phone and hung up. No paint shop was going to make me lose my job just when everything seemed arranged O.K.

Toward noon, Herman the Hero and I went over to the cafeteria. Herman was somewhat scared.

"John, supposin' she busts me up?"

"Nonsense," I chirped cheerfully. "You can run, can't you? Anybody can outrun a muscle-bound lady wrestler."

Little Lollipop was dishing out beef stew behind the hot table. Her sleeves were rolled up, showing her muscular arms, and her nose suggested the leaning tower of Pisa where somebody had stepped on it, but she had a cheerful smile on her large face and a big red rose in her hair that made her look somehow attractive and feminine.

Herman whispered hoarsely:

"She looks like a gal, but John, she's tougher to handle than a pair of iron pants. If she hollers 'hallelujah', start runnin'. She always hollers 'hallelujah' in the ring just before she begins bustin' a few bones."

I almost felt sorry for Little Lollipop as I went to a table near the serving line and commenced banging on a glass with a knife.

"Attention please," I yelled. "Herman the Hero has a small present he wants to give to Little Lollipop. Little Lollipop, will you please step out here a minute?"

It was a dirty trick all right to play on anybody, even a lady wrestler, and my conscience jabbed me as she came from behind the steam table, wiping some gravy from her big paws on her apron. She actually looked as though expecting something pleasant. She even giggled a little, and the lace collar around her neck danced happily.

While everybody in the cafeteria watched, Herman the Hero edged his 110 pounds within arm length of Little Lollipop's 170 pounds, and Herman the Hero addressed her thusly:

"Little Lollipop, I brung this just for you."

He was supposed to say more, to tell her it was a measure of his esteem, but he was too scared to remember. In fact, the expression on the long sad face of Herman the Hero said plainly that Herman wanted to run above all else in the world, the minute he handed her the box with his gift.

Still giggling, Little Lollipop pulled the top from the box the way she might yank the arm off an opposing wrestler, which is to say, eagerly. Then she looked into the box and for a long minute stood absolutely motionless.

"Hold it up," yelled the crowd. "Let's see what he gave you."

Slowly, Little Lollipop reached into the box, pulled out the dead rat and held it high so all could see. There was everywhere a shocked silence and personally, I felt worse than the rat.

Then Little Lollipop spoke, her lace collar quivering with emotion.

"Herman," she said in clear but trembling accents. "Nothing could please me more. But who told you that in my alley the gift of a dead rat means a proposal of marriage?"

Then her big arms reached out like forked lightning and caught Herman in an embrace that sounded as though his ribs were cracking but turned out to be only his pipe stem.

"Hallelujah!" shouted Little Lollipop. "We'll be married tonight, right after the citation ceremony. Hallelujah! Everybody come!"

I gave a last defeated look at Herman the Hero, struggling to speak from the depths of the arms and laces that surrounded him, and went back to my office where a note from Oscar, lying on my drawing board (it had been there no doubt all the time), explained everything.

u cant beat peepl (said the familiar henscratchings) hoo wont b beat bcaws they twist everything that happens 2 suit their purpuses and thanx 4 yesterdays mice

Amen, I thought, and especially lady wrestlers.

PRACTICAL HINTS AND KINKS

REPAIRING A HOT HIGH-PRESSURE VALVE

By DONALD RUSHMORE

RECENTLY WE FOUND it necessary to install a new seat and disc in a six in., high pressure, secondary stop valve for one boiler. The disc was split and allowed steam to leak through the valve. This condition made it impossible to work on the accessories to this boiler which was down for overhaul.

In order to repair the valve, the other boiler had to be taken off the line. This meant shutting down the entire mill. The job had to be done so a date was set and all preparations made. Included was a special spanner wrench which was made to fit the seat by welding ribs around the outside of a piece of five in. pipe.

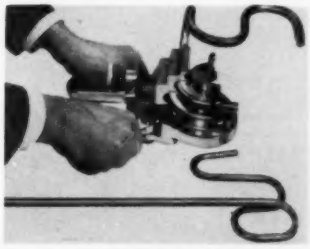
The job started off like clockwork. The bonnet came off easily, the old seat unscrewed without any trouble, and the disc came off the valve stem easily. Then the trouble began.

The valve, which was composed of several hundred lb of solid steel, had been in direct contact with 600 F steam when the other boiler was cut off. The main electrical switchboard was directly under the valve so that the valve could not be cooled with water. The instant the new seat, a small steel ring, touched this hot valve, it expanded and could not be screwed in. Since the mill could not start up until this valve was put together and closed, it caused quite a quandary.

The solution to the problem was simple — once it was thought of. The discharge end of a carbon dioxide fire extinguisher was put into the five in. pipe on a spanner wrench. Inside of this pipe was coated with snow while the seat was screwed into place. The cold pipe counteracted the hot valve and the situation was under control.

TUBE BENDER

GETTING A GOOD BEND, the way you want it in tubing, and not flattening it, is often a problem. The Tal Bender, Inc., has come out with a tool to help you do the job. This bender (shown in photo) can be used to make offsets and bends up to 180 degrees in $\frac{3}{8}$ in., $\frac{1}{2}$ in., and $\frac{5}{8}$ in. OD, K and L copper tubing, brass, Buncy weld, steel and other light gage tubing.



Bender in use showing examples of types of bends that can be made

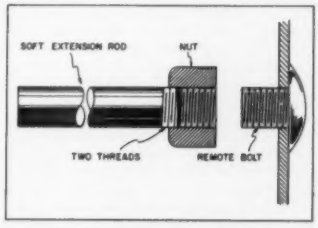
The bender is a strong, light weight, hand tool that is fast and simple to operate. Also no vise or fixtures are required. All three sizes, previously mentioned, are combined on the same tool.

The bender weighs five lb, and costs $38.00, FOB.

STARTING NUTS IN AWKWARD PLACES

By W. E. WARNER

STARTING NUTS in deep places is often awkward. A solution to this problem is to get a length of soft metal rod and cut two threads on one end of it of the same thread as on the nut. Screw the nut on the rod and then using it as an extension, screw the nut on the out of the way



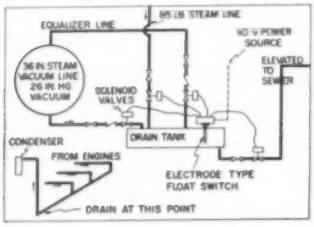
Construction view of nut-starter

bolt. See sketch. When the threads on the out of the way bolt get damaged, they can be trued by screwing a die on the end of the partially threaded rod, and again using it as an extension, run the die on the bolt.

VAPOR LINE CONDENSATE DRAIN

By MELVIN EVANS

RECENTLY, approximately 130 ft of 36 in. diameter vapor line was installed from our condensing engines to a barometric condenser operating at 26 in. Hg vacuum. The line had considerable condensate



Sketch showing setup for automatic condensate draining of vapor line

which needed to be automatically drained off. The sketch shows how this is done. The condensate, preferably, should go for boiler make-up and not down the sewer.

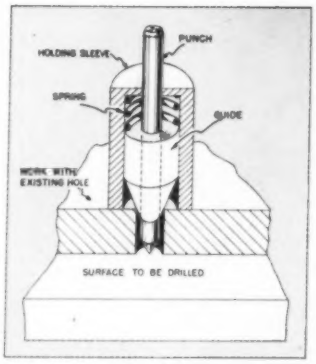
HOLE CENTER TRANSFERRING TOOL

By F. HUTCHINSON

IN ERECTING WORK, it is often necessary to transfer the center of a drilled hole to another surface so that two parts may be bolted accurately together. One way of doing this is to place the drilled piece in place and scratch onto the surface of the part to be drilled, the outline of the existing hole, by means of a scriber. The center of the scribed circle must then be found so that a center-punch mark may be made in order to start the drill. The resulting hole is often placed inaccurately and a lot of time is wasted in correcting the location.

By means of the hole center transferring tool, it is possible to place center punch marks accurately from an existing drilled hole. The tool comprises a hardened punch which is a close sliding fit in a conical ended guide. The exterior of the guide is a close sliding fit inside a holding sleeve which houses a compression spring for forcing the conical guide portion into the drilled hole.

In use, the tool is placed over the drilled hole, the operator gripping the exterior of the holding sleeve and pushing its lower face into contact with the surface in which the hole is drilled. This has the effect of holding the punch at right angles to the work surface and forcing the conical guide



Cross-section of hole center transferring tool

portion into contact with the edge of the drilled hole. A blow with a hammer on the upper portion of the punch will place a center punch mark in the work surface, exactly in line with the center of the existing drilled hole.

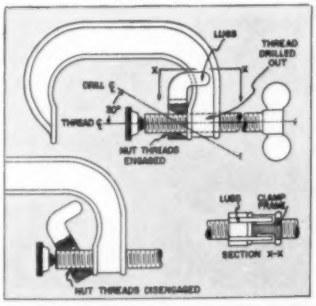
The minimum hole size on which the tool can be used is limited by the diameter of the punch. Where a wide range of hole sizes have to be provided for, it is advisable to make up several of these tools.

QUICK SETTING C-CLAMP

By O. K. HOADLEY

THE STANDARD C-CLAMP can be modified easily so that the screw can be pulled or pushed to release or clamp the work. The fitting of a quick release nut enables the clamp to be pushed quickly into contact with the work and eliminates a lot of tedious turning of the screw in order to open or close the clamp screw through long distances.

First, the threaded hole in the C-frame of the clamp must be drilled out to a diameter which will allow the outside diameter of the screw to slide freely. In place of the thread formerly in the clamp frame, a new nut is made which possesses the feature of allowing the thread to pass freely through when the nut is tilted over, but which engages firmly with



Details of quick setting C-clamp construction

the screw thread when any clamping pressure is sustained by the screw.

The nut is first threaded to suit the thread on the clamp screw and is then drilled at an angle of 30 degrees to the internal thread axis, to a diameter equal to the outside diameter of the male thread. A substantial part of the original thread is removed by the drill, but the remaining amount of thread is sufficient to ensure good clamping.

The position of the quick acting nut is shown in sketch. The nut has a pair of lugs which engage with the frame of the clamp and these prevent it from slipping around.

In use, the clamp is hooked on to the work and the frame and nut are gripped with the fingers of one hand and the clamp screw is pushed forward with the other hand. The nut will tilt forward and the clamp screw will slide freely forward until it contacts the work. A few turns of the screw will cause the nut to straighten up and the work to be clamped.

A few left hand turns will release the screw so that the nut can tilt forward and allow the screw to be pulled back. On long clamps of 12 in. or so, the quick release nut is a great time saver.

APPLYING BELT DRESSING SAFELY

By F. E. RILEY

ONE FORM OF DRESSING available for application to flat belts for the purposes of improving adhesion and for keeping the belt in good condition is supplied in the form of a solid cylindrical stick. The stick of dressing is surrounded by a stiff paper covering which supports the stick and prevents it from bending in use. The dressing is applied to the surface of the running belt. This operation is easy when the stick is new and has not worn down to a short length. When worn down to about two in. it is difficult to hold firmly in the hand and the running belt tends to pull it from the fingers. In this circumstance, there is the possibility of danger to the user.

These short sticks can be used safely, down to the last part of an inch, by making a wooden handle into which the short length can be clamped. The handle should be of some close-grained hardwood and bored with a hole to take the stick of dressing at one end. The hole should be intersected by means of a sawed slot so that the stick can be gripped tightly in the handle by means of a wood screw. A bolt and nut may be substituted for the wood screw if desired, but a wood screw will tighten the split handle for a long time before the threads wear out.

As another safety precaution, remember, always apply the dressing on that side of the belt which is running away from the pulley.

Basic Power Plant FIGURING

A Review for Old-Timers—A Must for Young-Timers

By **WILLIAM H. ENGELMAN** and **JAY P. AuWERTER**
Mechanical Engineer, Cleveland, Ohio
President, The C. E. Squires Co., Cleveland, Ohio

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How to Figure Trap Sizes Correctly

BEFORE YOU can figure out the correct size of trap to handle a given condensate load, you must know how to compute the quantity of condensate exactly. You were given complete directions for doing so in an article by these authors in POWER ENGINEERING, February, 1951. In that article, you were shown how to figure the condensate in pipe lines with fittings and on both bare pipe lines and insulated lines. Curves were included for the heat losses on bare Schedule 40 steel pipe, also losses for copper pipe, and correction factors for various wind velocities. You were also shown how to figure condensate for typical process installations, and condensate in submerged coil heating.

After you have figured just how much condensate you have to handle, the following will show you how to determine the proper trap size to handle it.

How and Why a Trap Factor

Once you have the condensate load, multiply this load by a safety or trap factor. This factor allows for two to three times normal load for majority of installations. When a surge load occurs, as when cold material is dumped into a steam kettle, or when large quantities of cold water are sud-

Table I. Continuous flow capacities of different sizes of steam traps for various initial pressures

Pipe Size	½″	¾″	1″	1¼″	1½″	2″	2½″
Pressure psig	Continuous Flow Capacities						
5f	2180	5000	6400	8820	12990	20020	25560
10f	3070	7040	9020	12430	18150	28200	36000
20f	1610	4380	5020	7390	9590	15840	19350
30f	1935	5280	6050	8900	11550	19080	23320
40f	1600	3700	4090	5170	8870	11830	15820
50f	1770	4090	4540	5730	9820	13090	17510
60f	1900	4400	5000	6160	10560	14080	18830
80f	1460	3000	3460	4520	7000	10000	11920
100f	1600	3300	3800	4970	7700	11000	13100
125f	1360	3070	3000	3530	5440	6850	10420
150f	1460	3300	3230	3800	5850	7370	11200
200f	950	2090	2680	3130	5060	7370	8360
250f	700	1375	2280	2910	4950	5500	7150

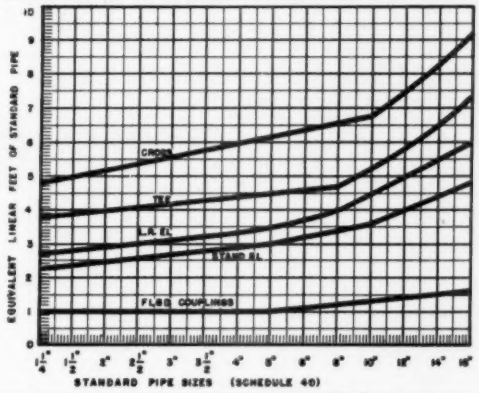


Fig. 1. Radiating area of 150-psi standard flanged fittings with companion flanges, expressed in linear feet of same size pipe

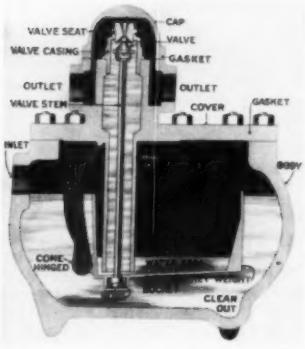


Fig. 2. Typical bucket trap details, showing water seal at bottom of bucket

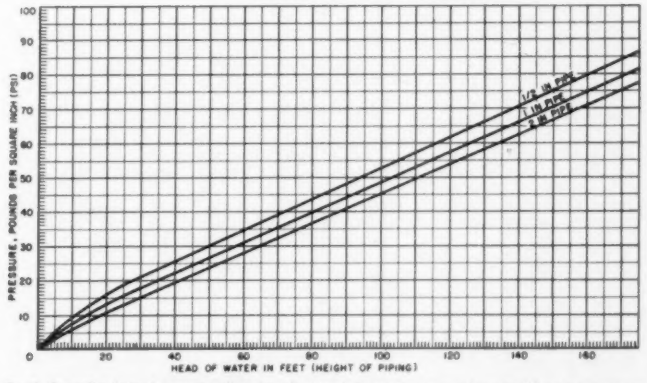


Fig. 3. Curve for determining vertical height in feet to which condensate can be piped for given pressure through trap. This takes account of pressure loss in line, through trap and through normal pipe fittings; consequently the curve is not a straight line down to 0 pressure

denly let into a hot water heater, a trap factor larger than two or three should be used.

For instance, if the average load is 1000 lb per hr of condensate, but this load is such that 300 lb of this 1000 lb is condensed in a period of 6 min, this peak load would be formed at the rate of 10 × 300 or 3000 lb per hr.

Thus a trap factor of four to five times the normal load of 1000 lb per hr should be used, to allow for intermittent discharge during this period.

The same methods for calculations given in the February 1951 article can be used to obtain these peak loads, and it is important to check trap installations for these loads to avoid flooding the trap and thereby decreasing the efficiency of the equipment being trapped. With this adjusted condensate load known, together with the pressure at which the trap is operating, next refer to Table I for the trap size to be used.

This table is a typical continuous flow capacity table for a bucket type trap. For the pressure at which the trap is operating (or the differential pressure across the trap, if it is discharging at other than atmospheric pressure) as shown in the left-hand column of Table I, read across horizontally until you reach the lb per hr figure equal to or greater than the adjusted condensate load. This figure is then located in the vertical column giving the trap size. DO NOT select a pressure lower than operating pressure or a trap of less capacity than is required, to avoid flooding. For example, for a 4000-lb-per-hr adjusted condensate load at 50 psi, the correct trap is ¾ in.

Table II. Flow of water (condensate) in pounds per hour and equivalent gallons per minute, with pressure drop through Schedule 40 (standard) pipe

Pounds of Condensate per Hour	Gal of Water per Min	Nominal and Actual Pipe Diameter in Inches							
		⅜″	0.494″	½″	0.623″	¾″	0.824″	1″	1.048″
		Vel, fps	Drop, psi	Vel, fps	Drop, psi	Vel, fps	Drop, psi	Vel, fps	Drop, psi
250	0.5	0.84	0.78	0.53	0.26	0.30	0.15	0.19	0.00
500	1.0	1.68	2.00	1.06	0.65	0.60	0.27	0.37	0.05
750	1.5	2.52	4.20	1.58	1.30	0.90	0.43	0.56	0.10
1000	2.0	3.36	7.25	2.11	2.30	1.20	0.61	0.74	0.18
1250	2.5	4.21	11.00	2.64	3.47	1.51	0.87	0.93	0.22
1500	3.0	5.05	15.15	3.17	4.90	1.81	1.26	1.11	0.39
1750	3.5	5.89	20.3	3.70	6.53	2.11	1.74	1.30	0.52
2000	4.0	6.73	26.0	4.23	8.32	2.41	2.17	1.49	0.66
2250	4.5	7.57	32.1	4.75	10.3	2.71	2.69	1.68	0.82
2500	5.0	8.41	39.0	5.28	12.6	3.01	3.25	1.86	1.01
3000	6.0			6.34	17.8	3.61	4.55	2.23	1.42
3500	7.0			7.39	23.4	4.21	6.07	2.60	1.87
4000	8.0			8.45	30.3	4.82	7.81	2.97	2.38
4500	9.0			9.51	37.3	5.42	9.70	3.34	2.95
5000	10.0			10.6	45.3	6.02	11.7	3.71	3.64
6000	12.0					7.22	16.5	4.46	5.10
7000	14.0					8.43	21.7	5.20	6.72
8000	16.0					9.63	27.7	5.94	8.70
9000	18.0					10.80	34.4	6.68	10.80
10,000	20.0					12.00	42.0	7.43	13.00
12,500	25.0							9.26	19.7
15,000	30.0							11.1	27.7
17,500	35.0							13.0	36.8
20,000	40.0							14.9	47.2

Pounds of Condensate per Hour	Gal of Water per Min	Nominal and Actual Inside Pipe Diameter in Inches							
		1¼″	1.380″	1½″	1.611″	2″	2.067″	2½″	2.469″
		Vel, fps	Drop, psi	Vel, fps	Drop, psi	Vel, fps	Drop, psi	Vel, fps	Drop, psi
2000	4	0.86	0.17	0.63	0.08				
2500	5	1.07	0.26	0.79	0.12	0.48	0.04		
3000	6	1.29	0.37	0.95	0.17	0.57	0.06	0.40	0.01
3500	7	1.50	0.50	1.10	0.23	0.67	0.08	0.46	0.02
4000	8	1.72	0.63	1.26	0.30	0.77	0.10	0.54	0.03
4500	9	1.94	0.77	1.42	0.36	0.86	0.12	0.61	0.04
5000	10	2.15	0.95	1.58	0.44	0.96	0.16	0.67	0.05
6000	12	2.57	1.34	1.89	0.62	1.15	0.22	0.80	0.07
7000	14	3.00	1.78	2.21	0.83	1.34	0.29	0.94	0.10
8000	16	3.43	2.25	2.52	1.06	1.53	0.37	1.07	0.13
9000	18	3.86	2.82	2.84	1.31	1.72	0.45	1.21	0.16
10,000	20	4.29	3.43	3.15	1.61	1.91	0.56	1.34	0.19
12,500	25	5.36	5.16	3.94	2.41	2.39	0.85	1.68	0.28
15,000	30	6.43	7.38	4.73	3.48	2.87	1.19	2.01	0.40
17,500	35	7.51	9.67	5.51	4.47	3.35	1.59	2.35	0.53
20,000	40	8.58	12.4	6.30	5.76	3.82	2.03	2.68	0.68
25,000	50	10.7	18.7	7.88	8.76	4.78	3.08	3.35	1.03
30,000	60	12.9	26.5	9.46	12.1	5.74	4.29	4.02	1.44
35,000	70	15.0	35.1	11.0	16.3	6.69	5.72	4.69	1.91
40,000	80	17.2	44.6	12.6	20.8	7.65	7.33	5.36	2.45
45,000	90			14.2	26.0	8.61	9.10	6.03	3.06
50,000	100			15.7	31.6	9.56	11.1	6.70	3.74
55,000	110					10.5	13.3	7.37	4.34
60,000	120					11.5	15.6	8.04	5.19
65,000	130					12.4	18.1	8.71	6.00
70,000	140					13.4	20.7	9.38	6.90
75,000	150					14.3	23.4	10.0	7.90
80,000	160					15.3	26.4	10.7	9.00
85,000	170					16.3	30.0	11.4	10.00
90,000	180					17.2	32.9	12.1	11.00
100,000	200					19.1	39.6	13.4	13.40

Fps = velocity in ft per sec to deliver given quantity
Psi = pressure drop per 100 ft of length

Use Proper Size Pipe to Trap

One general rule in installing traps is to use pipe from the equipment to the trap that is at least equal to the trap size. A second general rule is to install the trap as close as possible to the point where condensate is being formed. When the trap cannot be placed within a few feet of this point, or when a large number of fittings have to be used (increasing the equivalent length of pipe between the two points) it is wise to check the pipe size to see if it is large enough.

In doing this, add to the actual feet of pipe the equivalent feet of pipe for each fitting as shown in Fig. 1.

Next step is to refer to Table II. In this, find the proper load under the column Pounds of Condensate per Hour, then move across to the column for the pipe size of the trap selected and read the pressure drops through this size of pipe per 100 ft. The calculations below illustrate how to select the proper size pipe.

Sizing of Pipe to Trap for Pressure Loss

The pressure drop in psi from Table II should not exceed 10 per cent of the pressure under which the trap is working. See the following example:

Example:

A. The condensate to be handled is 4000 lb per hr.
B. Available initial pressure is 50 psi.
C. Equivalent length of pipe is 100 linear feet.

We must check whether the pressure loss through the pipe to be used is not more than 10 per cent of the initial pressure. Check it this way:

From Table II: Pressure drop in ¾-in. pipe per 100 linear feet is 7.81

lb, which is more than 10 per cent. Choose next larger size.

Pressure drop in 1-in. pipe per 100 linear feet is 2.38 lb, which is less than 10 per cent, hence O.K., and 1-in. pipe should be used.

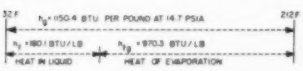
If the pipe to the trap, including fittings, has an equivalent length of 250 ft, then, with all other data remaining unchanged, the pressure loss would be 2.5 × 2.38 or 5.95 lb. This would then require a 1¼-in. pipe and the pressure drop would be 2.5 × 0.63 = 1.58 lb.

How to Figure Steam Flashing

When water under pressure and at the corresponding boiling temperature is suddenly discharged through a trap, or relief valve, to a lower pressure, a certain amount of heat is released, which causes some of the liquid to be flashed into steam. This is often the case in trap installations and not always recognized as such. The following completely worked out problems will greatly contribute to a better understanding of this flashing.

Example:

500 lb of water at 100 psia and the corresponding boiling temperatures of 327.8 F are released through the trap to the atmosphere at 14.7 psia. Find the heat release in Btu and the pounds of water flashing to steam.



At 100 psia, the heat in the liquid . . . . . = 298.4 Btu per lb
At 14.7 psia (atm. press.) the heat in the liquid . . = 180.1 Btu per lb
Available heat is the difference . = 118.3 Btu per lb
The total heat release is 500 × 118.3 = 59,150 Btu.
Pounds of water flashed to steam is 59,150 ÷ 970.3 = 61.0

It requires 970.3 Btu to evaporate 1 lb of water at 212 F and standard atmospheric pressure into dry saturated steam. Therefore it takes 970.3 ÷ 118.3 or 8.2 lb of water at 327.8 F to flash 1 lb of water at 212 F into dry saturated steam. While 1 pound of water has a volume of 0.01672 cu ft, the volume of steam at 14.7 psia is 26.80 cu ft, a volumetric increase in the ratio of 1606 to 1.

This additional information is given to show that such a large change in volume from water to steam is what causes bodies to explode and how lines normally carrying condensate can become steam bound. Also there will always be a certain amount of flash steam formed with all trap installations. This flash steam, in open bucket traps that have a positive water seal within them (hence no live steam loss), is often mistaken as the sign of a leaky trap. A typical open bucket trap is shown in Fig. 2 and this water seal is shown in the bottom of the bucket.

Height to Which Traps Can Force Condensate

In many installations, condensate from the trap has to be piped to a point higher than the trap itself. When this is to be done, the curve in Fig. 3 shows to what height the condensate can be piped, for various size pipes and pressures. The pressure on this curve refers to the line pressure, if the trap is discharging to atmosphere, or the differential pressure if it is discharging at other than atmospheric pressure.

A subsequent article will give diagrams of actual trap installations for various conditions.

Questions and Answers

Question No. 493

FRENCH ENGINEER ASKS ABOUT STEEL FOUNDATIONS FOR TURBINES

WILL YOU KINDLY tell us if the question of steel foundations for stationary steam turbines has been considered often in the United States and if this type of foundation has been used in any of the newest central stations?

Also, we should like to know if any books or articles have been published on this subject.

Paris, France — S.G.D.

Answer No. 488

WHY USE STEAM TO OPERATE TURBINES?

AS WE POINTED OUT in the December issue, this is a bona fide question, not a trick one. The questioner, S.J.W., is an industrial plant electrician, with little or no knowledge of the theories of heat engines and prime movers and very little background in general science. He knows how to handle the electricity that is delivered to him. But why, he wants to know, is the steam turbine generator the best way to produce it?

Why can't we drive that turbine with high-pressure compressed air or high-pressure water? Wouldn't they keep the turbine cooler? he asks.

Some readers *have* hit on the most important factor, which is the superior ability of steam to store up heat released by burning fuel, transport it from one place to another and allow it to be transformed into mechanical power. We cannot carry out those processes so cheaply or simply in any other way, especially in cases where we need process heat. The gas turbine, driven by heated compressed air, is beginning to make some changes in these ideas; but it is still in the early stages of development. By and large, we use steam because it is the cheapest way of handling fuel energy.

Well, here are more of our readers' ideas on the subject:

Until We Turn Heat Directly Into Electricity, We'll Have Turbines

HIGH-PRESSURE air, natural gas and water are now being used to operate turbines. Only limited sources of this energy restrict its use. Until a practical means arrives for converting heat energy directly to electrical energy, we can expect the steam turbine to be with us.

Yonkers, N. Y. — J. B. PRATHER

Where Would High-Pressure Air or Water Come From?

THIS QUESTION of S.J.W.'s certainly deserves an answer because it shows the spirit of inquiry that has originated most engineering progress. He notices an undesirable condition, proposes ways of correcting it and tries to find out whether his suggestions are possible and practical.

Answering the first part of his question, it would be possible, but not practical, to operate turbines with compressed air or cold water. Where does he expect to get his supplies of air or water? Of course, there are plenty of hydraulic turbines and water wheels running efficiently with cold water, but only at places where nature furnishes water in sufficient quantity at the required head.

If air were used, it would have to be compressed, which would necessitate some kind of power. Unless the plant is located where hydroelectric or hydraulic power is available, we would need a heat engine of some kind, which is what we are trying to get away from. Even with hydroelectric or hydraulic power, it is very doubtful whether a combined air compressor and air turbine could be run as economically as a boiler and steam turbine. In these days of competition and high costs of fuel and labor a power plant must be run as economically as is reasonably possible, or be driven out of business. It would be interesting if some turbine and compressed air specialists would give S.J.W. some figures on this question.

Compressing the air would heat it, so some cooling apparatus would be needed to get our desired result. This would add expense and complication.

Finally, S.J.W. asks what difference does it make what is used so long as it can make the turbine shaft turn over? To a turbine owner, it makes the difference between prosperity or bankruptcy whether his turbine shaft

turns over at a cost that earns a profit on his investment and operating expenses.

Philadelphia W.B.R.

Because Steam Gives Them More Energy, says Rieber

It is entirely possible to use either high-pressure compressed air or high-pressure cold water as well as high-pressure steam to operate a simple single-stage impulse type of turbine, but extremely impracticable. However, it does make a tremendous difference what is used to make the turbine shaft turn over.

Let's first have a look at how the steam turbine functions. Steam is led by suitable piping from the boiler to the nozzles of the turbine. In the nozzles, expansion takes place. In expanding, the steam drops in pressure but gains in velocity. Leaving the nozzles, the steam strikes the movable blades mounted on the rotor, causing it to revolve by the actual force of the steam on the blades, i.e., the kinetic energy of the steam is used to cause the turbine shaft to revolve.

All this indicates very definitely that either air or water under pressure can be used to turn the shaft of a turbine, but only a very small fraction of the turbine's rated horsepower could be developed by substituting either air or water for steam for the following reasons:

There are five forms of energy known today, namely, (1) Heat (2) Mechanical (3) Electrical (4) Chemical (5) Light. All forms of energy on our earth are derived from heat which is originally derived from our sun, the center of our solar system. All forms of energy consist of two divisions, Potential and Kinetic. In simple terms, potential energy is the stored energy, such as the electrical energy stored in a storage battery, while kinetic energy is that which is produced by a mass of matter in motion, thus the heavier the mass the greater the kinetic energy.

Of all the vehicles for transposing energy from one form to another, steam is one of the most important and efficient because it has the ability to store up large quantities of potential energy in the form of heat, plus its high differential pressure resulting in high velocity which develops kinetic energy to an amazing degree. Air and water contain very small amounts of potential energy depending on their respective pressures and must be in motion to have any expression of energy. One of the most inexorable laws of nature is the Conservation of Energy: — you cannot produce one form of energy without expending at least an equal amount of some other form. Therefore, a steam turbine designed to develop 1000 hp operating on steam would develop only a small fraction of its rating if operated by either air or water because there just isn't enough energy of any kind in the amount of air or water delivered to the turbine through the designed nozzles to match the amount of heat energy contained in the steam to produce the 1000 hp of mechanical energy on the turbine shaft.

Many more millions of horsepower are being developed throughout the world by water power with Francis and Pelton wheels for high head pressures and propeller type wheels for lower head pressures, but enormous quantities of water pass through this type of turbine as compared to the modern steam turbine.

In the case of cold water, with a high head pressure, the only energy it contains is kinetic due to position. The total kinetic energy of this water would be expended in the first stage of the turbine; and, as Charles Law does not work in the case of a liquid, the water would not expand to fill up the increasing volumes or volumetric capacities of the succeeding stages in the turbine. This water would slosh around the blading of the lower stages, actually acting as a brake on the rotating motion, thus absorbing so much energy in the form of heat from friction of the blading so as to cancel out the net energy transmitted in the first stage. The first stage would be relatively cold and the last stage would be relatively hot, in direct proportion to the initial energy in the high-pressure water.

So, I am very much afraid that S.J.W. will never see a modern multi-stage steam turbine operating with anything other than steam.

St. Louis, Mo. A. F. RIEBER

So You Won't Use Up 100 hp to Develop 30 hp

USE OF AIR or gas as the operating medium in turbines is possible and practical, but only if the air or gas is available at high pressures, from same process, and must be reduced in pressure. In this case, the turbine acts as a reducing valve and any power developed is free, that is it is not chargeable to power. The air or gas must be dry or the turbine will freeze up with ice forming in the nozzle and exhaust.

If the air, for operating the turbine, must first be compressed and then expanded in the turbine the process is not economical. It is too much like trying to lift yourself by your boot straps. (See note above about the gas turbine. — Ed.)

Assume a 100-hp motor driving an air compressor. The motor would deliver approximately 85 hp to the compressor, due to motor efficiency. If the compressor efficiency is 50 per cent there would be 42.5 hp stored in the air. If this high-pressure air is then put through a turbine, with an efficiency of 70 per cent, approximately 30 hp will be delivered to the turbine shaft. In other works, we have used 100 hp to develop 30 hp, which is not practical.

The Pelton water turbine is still used when water at high pressure is available. A 100-hp turbine using steam at 100 psig and exhausting to atmosphere would theoretically require 2271 lb of steam per hour. A hydraulic turbine using the same amount of water, 2271 lb of water per hour, would require a theoretical water head of 87,200 ft or a pressure of 37,800 psi. If the water pressure were the same as the steam pressure it would require 860,000 lb of water per hour. It is apparent from a comparison of the quantities and pressures that the water turbine cannot compare to the steam turbine.

Wellsville, N. Y. R. B. DODDS

Because It's Best Energy Carrier

A TURBINE could be designed to operate on compressed air, but whence the compressed air? A compressor would be required, and as both turbine and compressor would be less than 100 per cent efficient, the compressor for a given turbine would require more power than is developed by the turbine itself, because of inherent losses.

Assuming the impossible — that both are 100 per cent efficient — there still would be no gain in a machine that merely drives itself.

High-pressure water is frequently used to drive turbines — (witness the impulse turbines at Dixence, Switzerland operating under 5600 ft head or about 2400 psi) but we must have water at an elevation higher than that of the turbine, or at some pressure higher than operating pressure. This means that unless we are situated on a flowing stream of water that can be diverted to flow through a turbine, we must pump water back up into the reservoir above the turbine, again introducing a turbine that drives a pump that can't quite keep up because of inherent losses. Again, assuming the impossible, 100 per cent efficiency, we still would have a machine that merely drives itself, and would have no power left over.

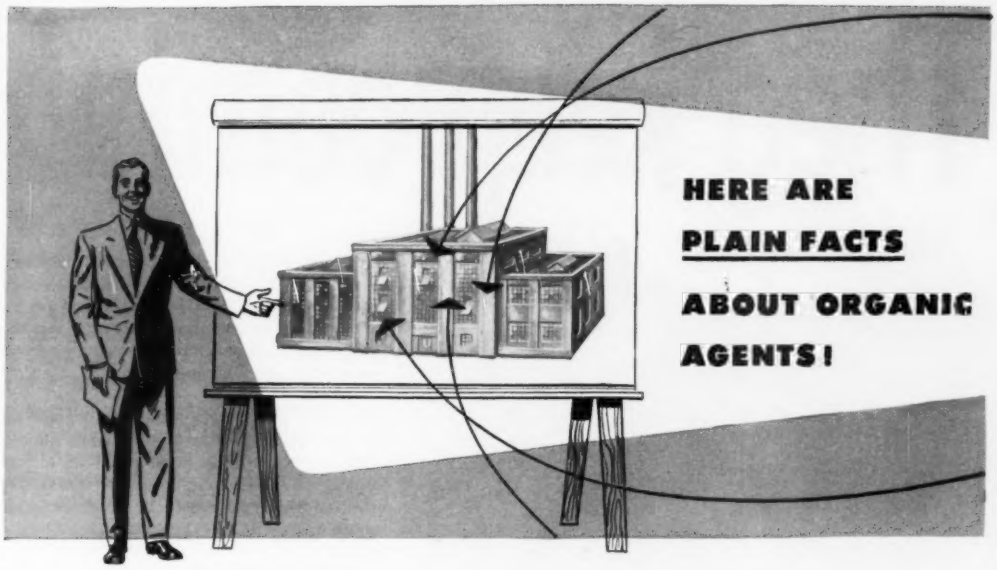
What, then, is the advantage in using steam to drive a turbine? Simply, that it uses a form of energy that is available wherever there is water and a combustible fuel. Fundamentally, energy is capacity for doing work. It is stored work. Water in an elevated reservoir is stored energy because of its position, but the reservoir when empty must be refilled.

Water can also be used as a reservoir for heat energy, by introducing it into a closed vessel and applying heat. Some of the internal energy in coal is released during its combustion, and is transferred to the water in a boiler, the resulting steam being expanded in a turbine nozzle, giving up some of its energy to the rotating blading, driving a generator or other machine. Under ordinary conditions, 10 lb of water can absorb enough heat energy from 1 lb of coal to generate 1 kw of electricity in a turbine.

On the other hand, it will take over a ton of water falling a thousand feet to provide the energy required to generate 1 kw of electricity in a water turbine.

LAWRENCE M. LARSON

Milwaukee, Wis.



HERE ARE PLAIN FACTS ABOUT ORGANIC AGENTS!

Many times the full and proper use of organic agents is not included in a water conditioning program. And many times the results are far from satisfactory.

Take, for example, the case of a large paper manufacturer who was having considerable difficulty with blistered tubes which resulted in plant shutdown. The major difficulty with tube burnouts was confined to a single 500 psi unit rated at 200,000 pounds of steam per hour. Thin, hard scale developed in the first row of generating tubes exposed to the most intense heat.

With internal treatment by inorganic agents alone and the continuous maintenance of adequate soluble phosphate content of the boiler water, forced outage due to tube burnouts occurred three or four times yearly. And, the boiler was turbined at least twice yearly.

Betz engineers studied the problem and recommended the use of organic agents to supplement the external softening and inorganic treatment. Results? Since the application of organic treatment, no tube losses have occurred due to internal conditions for seven years! In fact, the boiler has operated for over three years without turbining or acid cleaning! Under present plant operation, the need for turbining or acid cleaning is not anticipated.

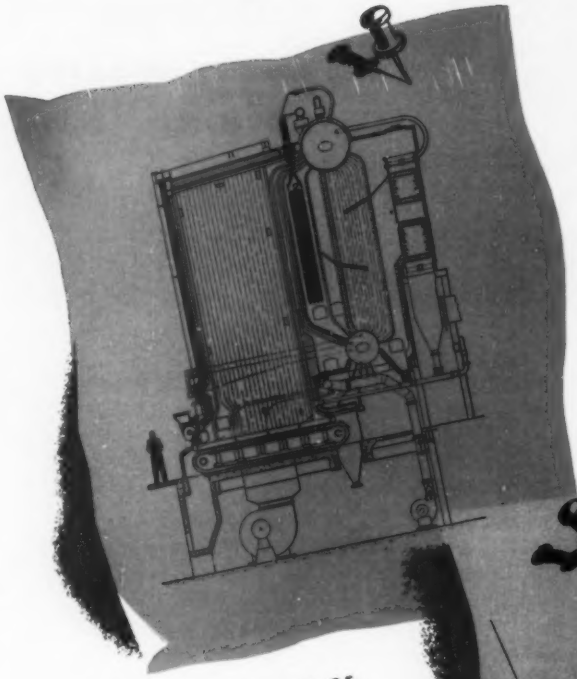
If your plant is plagued by scale and sludge deposits, why not do something about it *now*, by calling in a Betz Engineer. He'll show you factual evidence how Betz *Specialized* Water Conditioning Service can help you solve your water problem. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

Write today for a copy of Betz Technical Paper No. 98, "Boiler Scale —Its Formation and Prevention."

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

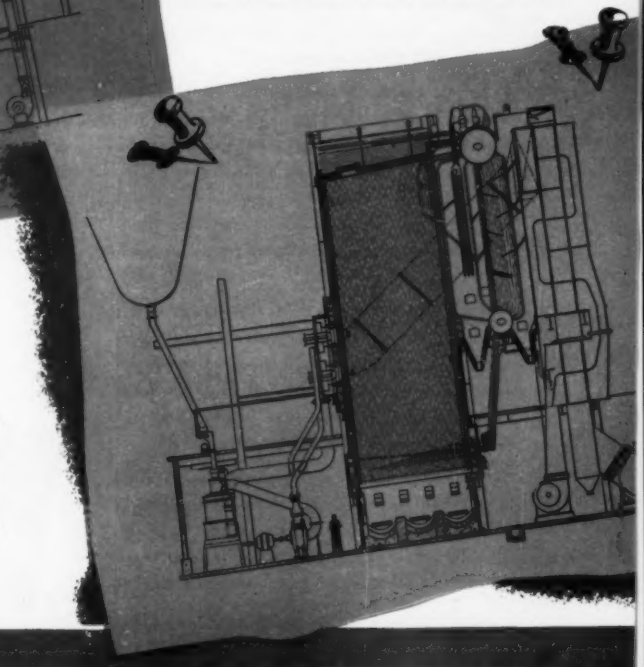
They keep coming



Companies that have bought VU Boilers *continue to buy them.* In fact, a substantial proportion of all VU Units, in service and on order, have been purchased by organizations whose selection reflects their own first-hand experience. *For example —*

A STEEL COMPANY now has a total of eleven VU Boilers in four different plants. Starting with three units in 1936, it has reordered three times... most recently in the fall of last year with an order for three more units.

A TEXTILE MANUFACTURER ordered two VU Units in 1936. Another unit was installed in 1940 and a third in 1944. Still another



VU-50 Unit fired with C-E Spreader Stoker (continuous discharge type). The capacity of unit shown is 80,000 lb steam per hr; operating pressure 425 psi steam temperature 650 F.

VU-50 Unit fired with pulverized coal. The capacity of unit shown is 200,000 lb of steam per hr; operating pressure 560 psi; steam temperature 760 F (VU units are in service for capacities up to 350,000 lb of steam per hr).

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

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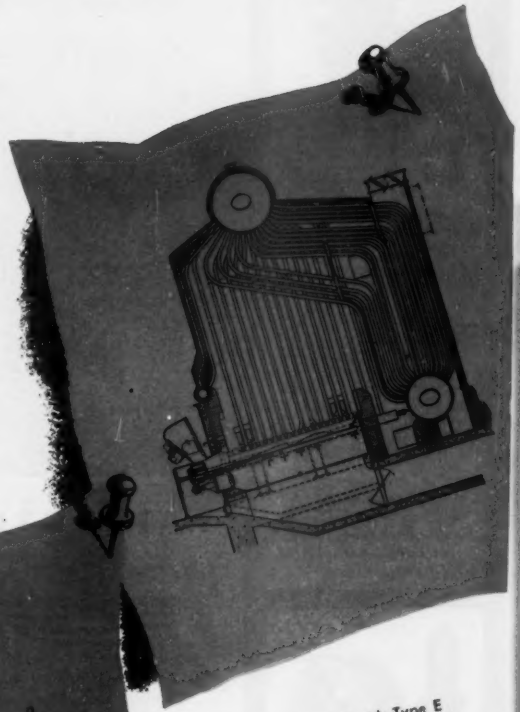
textile company installed one unit in 1945, a second in 1949 and has just ordered another.

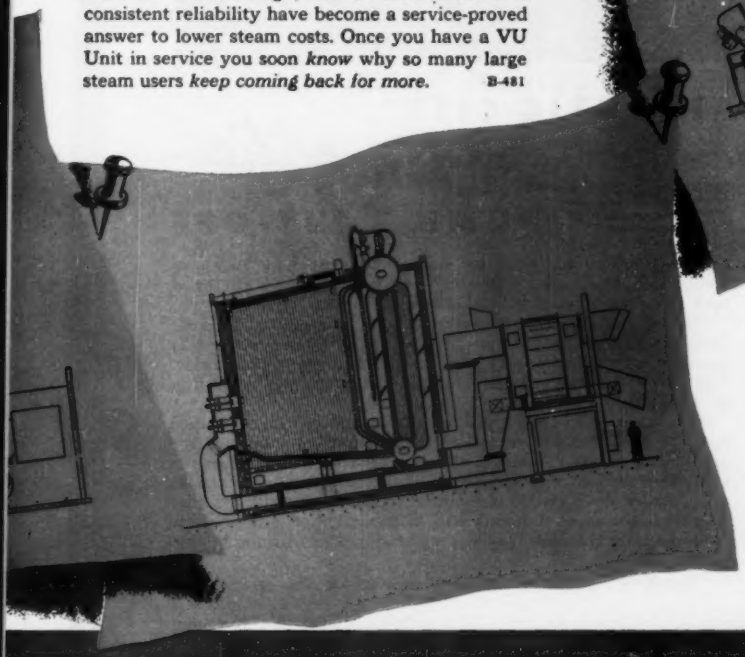
A REFINING COMPANY ordered one VU Unit in 1937, another in 1940 and another in 1949 for one of its plants; also two in 1942 and one in 1947 for another plant.

A SEWAGE TREATMENT PLANT in one of America's large cities is another consistent buyer of VU Boilers. Its initial order in 1936 was for two units. Since then it has reordered three times, and now has a total of seven VU Boilers in service.

• • •

The story is the same wherever you go — in all sections of the country American industry is ordering and *reordering* VU Units. Why? Because the VU's advanced design, sound construction and consistent reliability have become a service-proved answer to lower steam costs. Once you have a VU Unit in service you soon *know* why so many large steam users *keep coming back for more.* B-481





VU-10 Unit fired with Type E Stoker. VU-10 Boilers range in capacity from 10,000 to 60,000 lb steam per hr. They may be fired by spreader, underfeed or chain grate stokers, or by oil or gas.

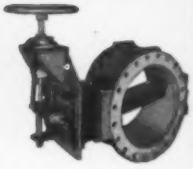
VU-50 Unit fired with oil or gas. The capacity of unit shown is 175,000 lb of steam per hr; operating pressure 400 psi; no superheat.

— SUPERHEATER, INC.

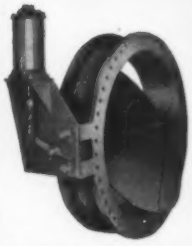
200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

No. 797—24-inch heavy duty electric motor operated valve. Handwheel for manual use in case of current failure.



No. 700—20-inch class "B" cast iron valve equipped with heavy duty handwheel control and threaded reach rod.



No. 627—Cylinder operated 60-inch heavy duty valve (either pneumatic or hydraulic control).

R-S Valves are synonymous with the simplified control and shut-off of any material that flows or is forced through a pipe, under a wide range of pressure and temperature.

R-S valvEvents

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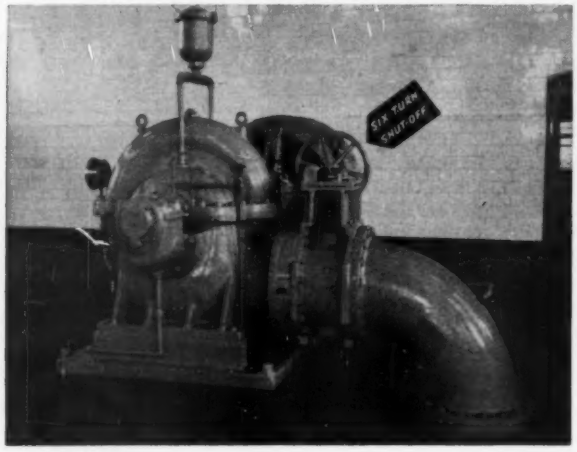

ATLANTIC CITY Simplifies PUMP SHUT-OFF

New pumping units of the modern Atlantic City Pumping Station supplying water for this seashore resort are equipped with 125-pound handwheel operated R-S valves.

The valve illustrated above is closed in a matter of seconds (only six handwheel revolutions required) before the pump is started in order to prevent an overload on the pump and motor. The valve is then opened gradually and easily regulated according to demand.

Such valves can be equipped with hydraulic cylinders (tapped into the pipe line before and after the pump). As long as the differential pressure remains above a predetermined value, the cylinder will hold the valve open. Power or mechanical failure will cause a drop in the differential pressure, and the cylinder will close the valve automatically. Water hammer is impossible since the valve closes only as fast as the adjustable cylinder bleeds.

Specify R-S Valves for simplified construction and operation.

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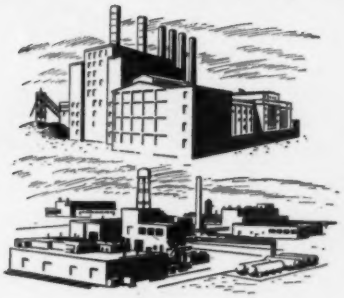


→ In the Bituminous lands of the B&O, progress never stops. Year after year, enterprising coal producers back their faith in B&O coals with new mines and processing plants, with increased mechanization and up-to-the-minute equipment.

B&O Bituminous lends itself to modern, low-cost mining. Because of its nearness to America's industrial heart, transportation costs are moderate. Markets are dependable, and there is a wide variety of coals to meet all needs.

Smart consumers "bank on B&O Bituminous"—its sources and reserves are known and great.

Ask our man!

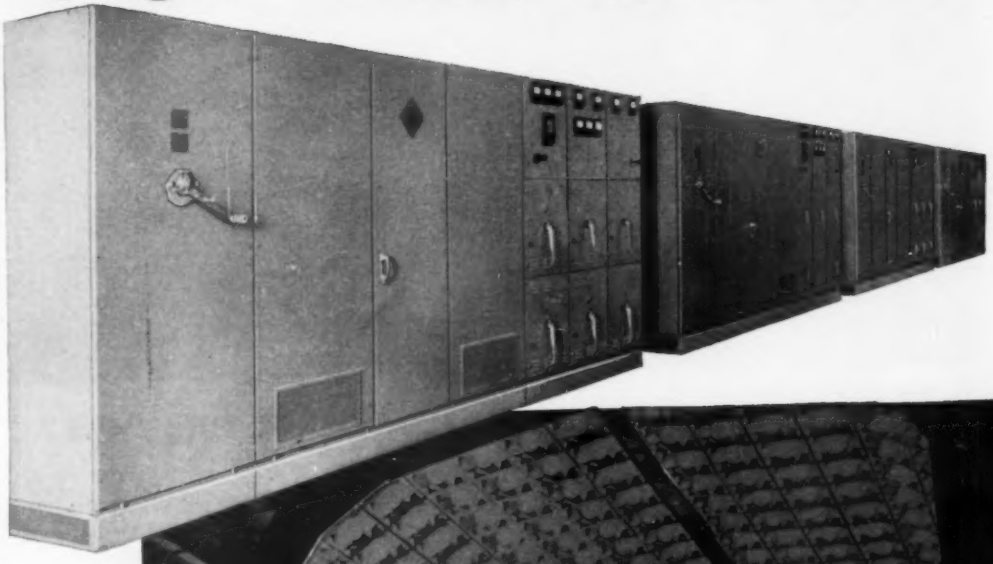
BITUMINOUS COALS FOR EVERY PURPOSE

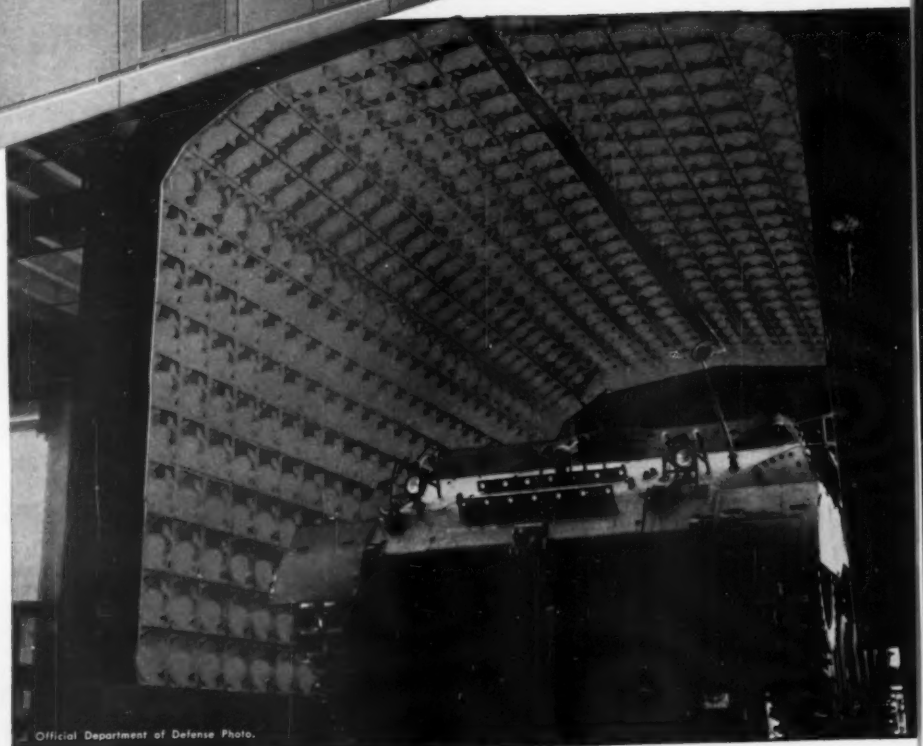
BALTIMORE & OHIO RAILROAD

Constantly *doing things* — better!

ALLIS-CHALMERS

PUT THE "Heat"





Official Department of Defense Photo.

UNIT SUBSTATIONS

ON PRODUCTION!

YOU CAN INCREASE the production of your plant without adding production equipment or hiring more help . . . just eliminate undervoltage. Motors, lights, heating units—all electrical equipment gives top performance only when operated at full voltage.

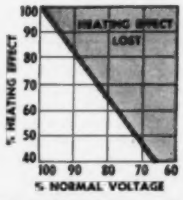
Paint baking or drying operations take longer when voltage drops. For example, a 10% drop reduces heating effect of infra-red lamps 19% . . . slows production. One paint drying operation required 63% more time when voltage dropped 10%.

A major cause of undervoltage is long, heavily loaded 480 volt feeders. Install Allis-Chalmers LCS Unit Substations at load centers and eliminate excessive line drop by shortening low voltage cables. Performance of all electrical equipment will improve . . . and personnel efficiency will increase because of better illumination from existing lighting fixtures.

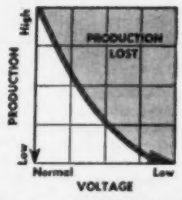
You can count on the cooperation of experienced Allis-Chalmers substation engineers in working out your distribution system. Allis-Chalmers LCS Load Center Unit Substations are neat, compact, easy to install and provide protection to personnel. Get in touch with your A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3372

LCS Unit Substations

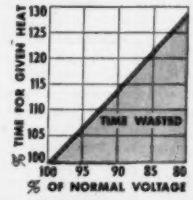
HOW UNDERVOLTAGE WASTES MANHOURS . . . CUTS PRODUCTION



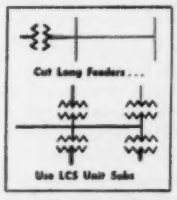
FULL OUTPUT from existing equipment demands full voltage. Heat output of infra-red lamps (used for baking paint on metal, drying coils of electrical apparatus and similar applications) drops with undervoltage. Output of resistance furnaces also drops off as the square of undervoltage.



PRODUCTION LOSSES RESULT from undervoltage. In one case a 10% drop in voltage cut the output of an infra-red drying oven from 1500 pounds per hour to 1275. Undervoltage means less work done each day . . . greater overhead for the work done, more manhours to be figured into every job.

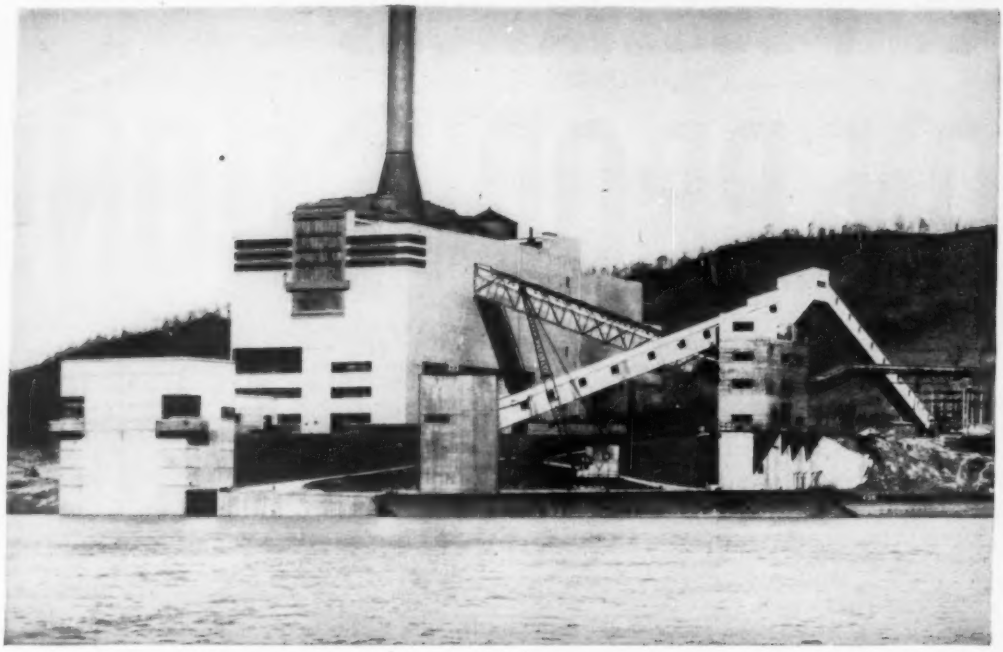


TIME IS WASTED when undervoltage is distributed to infra-red bulbs and other heating devices. It takes longer to deliver the same amount of heat . . . longer to do a given job. In one plant, drying time for black painted sheet steel increased from 11 to 18 minutes by a 10% drop in voltage.



A MAJOR CAUSE OF UNDERVOLTAGE is voltage drop in secondary feeders. Long low voltage lines may prove inadequate as production schedules are stepped-up and new machines added. Install substations at load centers to cut feeder length, reduce voltage drop and increase production.

ALLIS-CHALMERS



Unique Circulating Water System Installed in This Power Plant

The R. E. Burger steam-electric plant of Ohio Edison Company is located on the Ohio River well above flood stage—which may reach as much as 60 feet above extreme low water. Water is supplied to the condensers by a patented circulating water system pioneered jointly by Worthington and the consulting engineer, Mr. George W. Saathoff.

All major equipment except circulating pumps, which are designed to operate completely submerged if necessary, are located above flood stage.

The new installation of a Worthington 70,000 sq ft two-pass condenser and auxiliaries, serving a 90,000 kw turbine-generator, is the third Worthington unit in this station. Two 46,000 sq ft condensers were previously installed.

For advice on any new installation or information on a wide range of power plant equipment, consult Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

HOW IT WORKS

Two full-capacity circulating pumps are used in series.* The primary pump, submerged below extreme low water, is a Worthington motor-driven HIFLO. Its high starting head characteristic is able to deliver enough water for starting purposes. A booster pump—a single-suction volute Worthington MIXFLO, mounted directly upon an hydraulic turbine—starts when there is enough water in the control well. The two pumps then operate automatically in series at full capacity.

Advantage is taken of maximum siphon effect from the condenser drop leg which enters the sealing or control well. From this well, all circulating water is passed through the hydraulic turbine. Thus the static head from sealing well to river level is utilized—75-80% being recovered—in reducing the work of the primary pump, with saving in overall pumping power.

The booster pump functions until rising water renders the turbine ineffective. Then the primary HIFLO works alone, producing full capacity under reduced head.

*In the new unit, there are two half-capacity primary pumps, permitting operation of only one in the winter when low water temperatures prevail.

Z.1.1

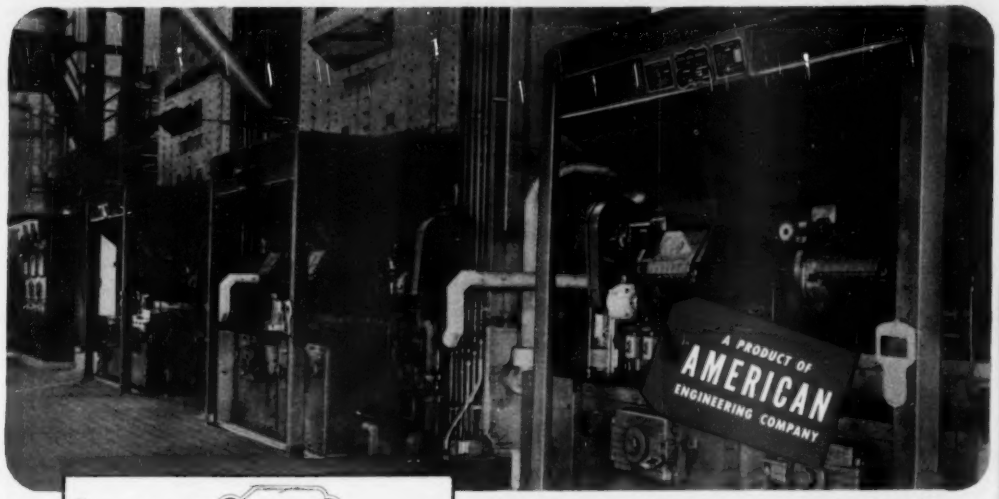
WORTHINGTON

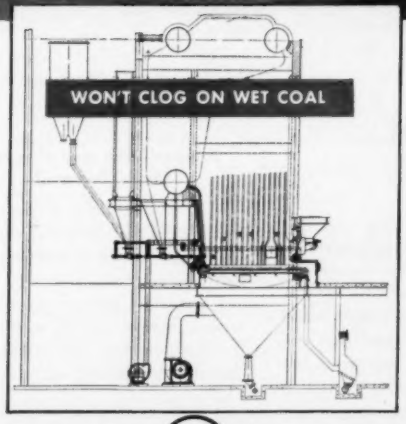
WORLD'S BROADEST LINE OF STEAM POWER PLANT AUXILIARIES

Feed Water Heaters · Boiler Feed Pumps · Steam Turbines
Steam-Jet Ejectors · Water Treating Equipment · Surface Condensers

TOP EFFICIENCY FROM LOW AND HIGH ASH COALS

PERFECT SPREAD STOKER





Three AE Perfect Spread 2-feeder, travelling grate Stokers recently installed by a leading pharmaceutical manufacturer in the midwest. The boilers, each with a maximum continuous capacity of 60,000 lbs. per hour are Union "A" Type. Efficiency at normal capacity, 83.4%; at maximum capacity, 82.4%. Consulting Engineer, Austin Company.

In the Boiler Room illustrated, the Perfect Spread Stokers were guaranteed to use coal containing either 13,306 B.T.U. or 11,327 B.T.U. per lb. as fired. These two coals have moisture contents of 4.7% and 10.7%, with ash content of 8.2% and 10.1%, respectively. With either coal, practically the same capacity is available but these Perfect Spread Stokers have done even better than predicted. Five different grades of coal have been used to date . . . and all with top efficiency.

Perfect Spread's unique feeder won't clog on wet coal but feeds uniformly—not in slugs—regardless of moisture content. Its engineered cinder return and adjustable overfire air system give comparable results from either low or high ash coals. Its even feed characteristic insures higher CO_2, freedom from smoke puffs, minimum carbon in the ashpit, and less fly ash. Feeders adjustable from 50 to 7,500 lbs. of coal per hour . . . capacities range from 8,000 to 500,000 lbs. of steam per hour. Mail coupon today for full data.

AMERICAN ENGINEERING
COMPANY
PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers

American Engineering Company
2408 Aramingo Ave., Philadelphia 25, Pa.

Gentlemen: We are interested in saving fuel dollars. Kindly send booklet giving full information about Perfect Spread Stokers.

Name ..... Title .....

Company .....

Address .....

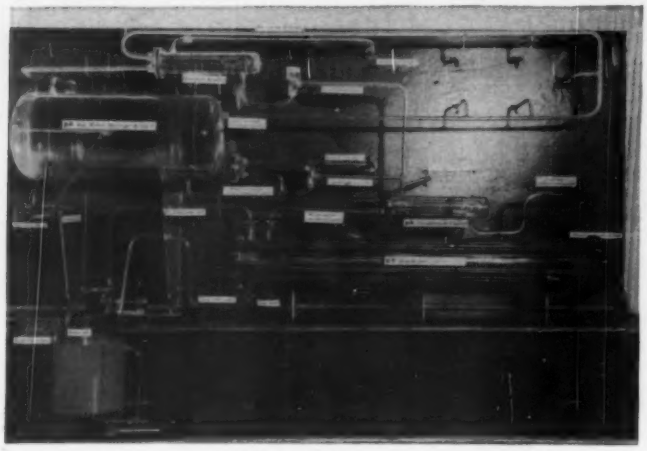
City ..... Zone ..... State .....

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

"Bridgeport" MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



Plastic model of a hot process water-heating system for laundries, textile plants and process industries. Saves 30 to 60% fuel. Relieves overloaded boilers. Courtesy: The Patterson Kelley Company, Inc., East Stroudsburg, Pa.

Reclaiming Waste Heat Pays Big Dividends

Since every cloud of steam escaping into the atmosphere and every discharge of warm liquids into sewers represents loss of valuable heat, it is no wonder that much thought is being given to the recovery of waste heat which may represent from 30 to 60% of the fuel used for generating steam.

Lower Fuel Bills

Every plant using an abundance of hot water or steam for processing, washing, cooking, sterilizing, heating, etc. is a potential prospect for making worth-while savings in its fuel bill and thereby reducing its cost of operation. In many instances the cost of special equipment for reclaiming waste heat will pay for itself in one or two years and represents an excellent investment.

The illustration above shows a plastic model of a water heating system for laundries, textile plants and process industries. Laundries generate steam and use about two-thirds of it for making hot water and the balance for presses, flatwork ironers and driers. The production of hot water represents the highest cost of operation. To reduce the cost of heating water it is necessary first to reclaim the heat from the hot waste water; second, the heat from exhaust steam; and thirdly, from high pressure condensates.

The hot water which ordinarily drains through the sewer and has a temperature between 120 to 130° F is first drained through screens to hold back foreign matter and is discharged into a sump from which point it is picked up by a non-clog, self-priming pump which forces the water through the tube of a closed type reclaimer.

Heat Salvaged from 4 Sources

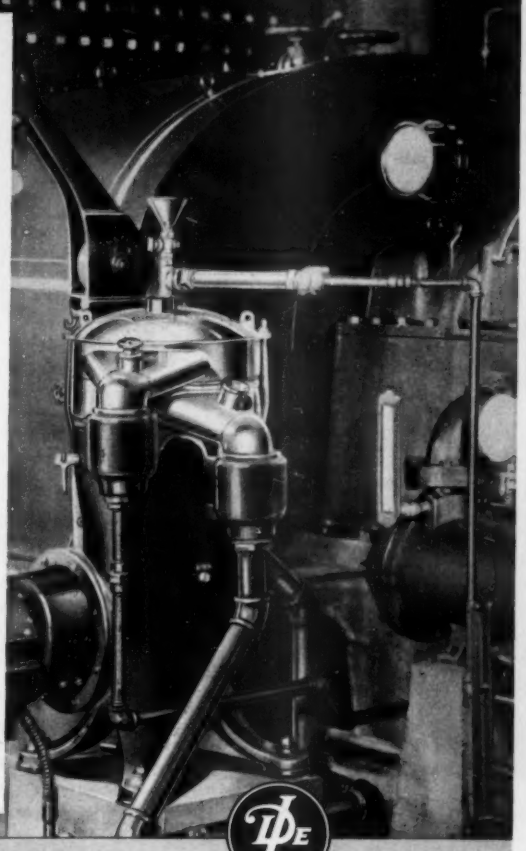
Incoming fresh, clean water is circulated on the outside of the tubes, which are generally made from copper. The temperature of the waste water in the exit end of the reclaimer drops between 70 to 80° F and brings up the temperature of the fresh water entering between 40 to 55° F to from 90 to 110° F. After it leaves the reclaimer the waste water is discharged to the sewer while the heated fresh water goes to the condensate cooler. Here it picks up heat from the condensate, from high pressure steam from the machine, and from the booster heater in the plant. It then goes to the hot water storage heater. Exhaust from the steam water is condensed through a copper tube nest in the storage heater and raises the temperature of the water in the storage tank to approximately the temperature required for processing.

Temperature and Pressure Held Constant

A circulating pump is used to discharge water from the storage heater to the booster heater, to maintain a constant temperature, generally 180° F, and a constant pressure to the washroom or processing machine. This water is continually circulated to maintain a uniform temperature and pressure.

Coils of tubes are either of copper or Admiralty brass or one of the other condenser tube alloys depending on the corrosive nature of the waste liquid. Duplex tubes are required whenever two different corrosive liquids are involved. Duplex tubing can be made in various combinations of materials to offset most kinds of double corrosion conditions. Combinations of Admiralty brass, aluminum bronze, aluminum brass, copper, cupro nickel, Muntz metal, naval brass, silicon bronze, aluminum, lead, nickel, low-carbon steel and stainless steel are popular. (7881)

By-Pass



De Laval centrifugal purification is the best possible means to keep lubricating oil clean. But even a De Laval machine will give better results on continuous by-pass than when used to purify "batches" of oil periodically.

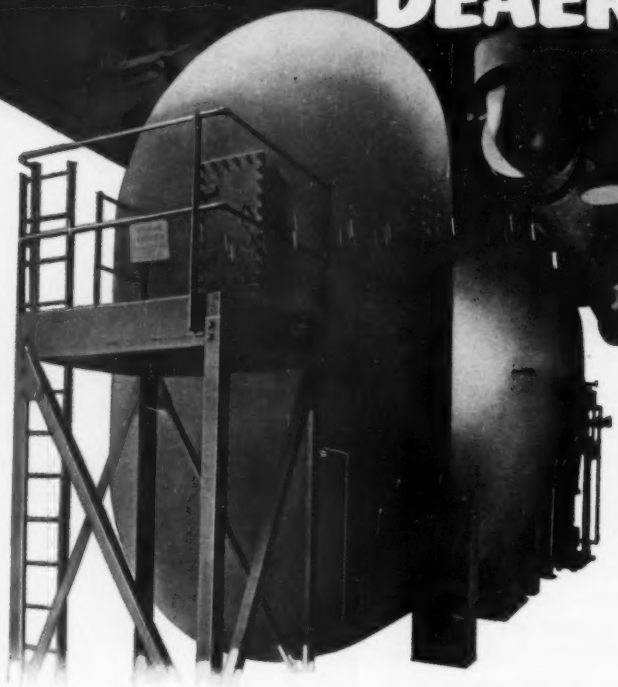
Because De Laval by-pass purification is a continuous process, its advantage over "batch" methods is that any leakage of water to the lubricating oil system can be detected immediately. Any increase in the water discharged from the purifier, which is operated continuously, shows up at once. There is no chance for any dangerous amount of water to collect in the oil.

A De Laval Oil Purifier of proper size on continuous by-pass will clean all the oil in the system every six to eight hours. Obviously, the rate of purification depends on viscosity of the oil and the size and weight of the contaminants.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO. 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited Peterborough, Ont.

DE LAVAL

COCHRANE MULTI-STAGE DEAERATOR



At the left is shown a Cochrane Multi-Stage Deaerator, of elliptical design, installed in one of the country's most important electric generating stations. With a capacity of one million pounds per hour, it deaerates returned condensate to zero oxygen (0.005 cc. per liter) before being fed to the high pressure boilers.

Below is shown one of two Cochrane Multi-Stage Deaerators — capacity 40,000 lb./hr., handling 100% make-up at a prominent public utility station.

COCHRANE originated and for many years has supplied the MULTI-STAGE DEAERATOR for the complete deaeration of 100% cold saturated water and for turbine condensate or other supplies where the difference in water inlet and outlet temperatures may be as small as 20° or 30° F. It is designed as two heaters in series. The top heater is of the jet type and the lower heater of the down-flow tray type. In the jet heater, the water is heated to within a few degrees of steam temperature and the bulk of the non-condensable gases are liberated. The water, with very low oxygen content, passes down to the tray heater where complete heating and deaeration takes place. The first heater acts as a direct contact vent condenser for the second heater, permitting omission of the vent condenser.

Write for a copy of Publication 3005.

COCHRANE CORPORATION, 3123 N. 17th St., PHILADELPHIA 32, PA.

In Canada: Canadian General Electric Co., Ltd., Toronto • In Mexico: Babcock & Wilcox de Mexico, S. A., Mexico City

In Europe: Recuperation Thermique & Epuration, Paris

COCHRANE

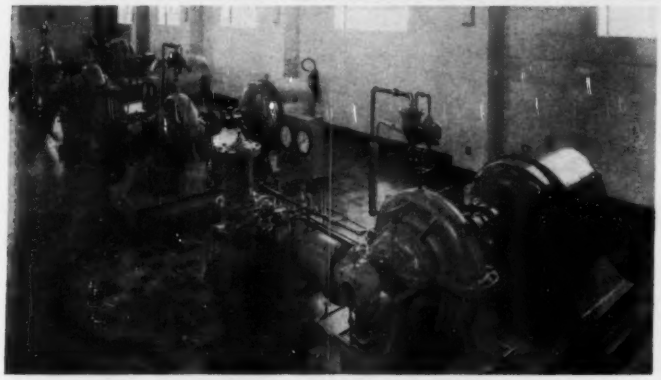
COCHRANE CORPORATION 89 YEARS OF SERVICE 1863 - 1952

PIONEERS AND LEADERS IN BOILER FEED PROCESS & INDUSTRIAL WATER CONDITIONING

WORTHINGTON

POINTERS ON PUMPS

Prepared for Industry by Worthington Pump and Machinery Corporation



A Plan That Gets the Most out of Centrifugal Pumps

Easy-To-Install Maintenance Program Means Better Performance, Longer Life

You can't get maximum production when your equipment's operation is constantly interrupted due to breakdowns. Moreover, today's equipment shortages make it increasingly more important that you get all the life you can out of your present machines.

We'd like to suggest a maintenance plan that will help you get the most out of one of your most vital pieces of equipment—centrifugal pumps.

Keep Informative Records

If you haven't already done so, it's a good idea to begin your maintenance plan by setting up a card index file so that you can catalogue each pump in your plant. Each card should contain the following information: plant pump number, size, manufacturer's name and style, serial number, date installed, and any other data which will help you to rapidly locate repair parts lists and manufacturer's parts numbers.

The rest of the card can be divided into a number of columns: Repair Date, Part Affected, Remarks, and Cost. A typical card is shown here.

PUMP MAINTENANCE CARD

_____ PUMP NO.	_____ MANUFACTURER
_____ SIZE	_____ MFGR'S ADDRESS
_____ DATE INSTALLED	_____ MFGR'S SERIAL NO.
_____ LOCATION	_____ MFGR'S STYLE

DATE	PART	REMARKS	COST

If you're careful to enter every maintenance or repair operation on the proper card, it won't be long before each card indicates a particular pattern of maintenance.

Set Up A Maintenance Schedule

Once this pattern is established for all the cards, you can set up a schedule of maintenance points for such items as: packing, greasing or oiling, painting, gasket replacement, and bearing examination. You may find, for example, that a unit or group requires packing maintenance about once every three months, and greasing once every four to six months, etc.

Your next step is to arrange a plant schedule so that a particular pump may be shut down for maintenance at or before these times. Thus you make it possible to do the maintenance work under proper and unhurried conditions to assure maximum conformity of production consistent with long pump life. In addition, examination of the card catalogue will guide operating and maintenance personnel as to quantity of repair parts they should keep on hand.

Make Periodic Inspections Externally

It is considered *inadvisable* to open pumps for inspection.

Rather, recent practice is to let pumps stay on the line until such time as external symptoms indicate overhaul may be required. These symptoms involve either a reduction in effective capacity because of wear at the internal clearance points or mechanical difficulties, such as vibration or noisy operation.

Parts requiring most frequent replacement in centrifugal pumps are: wearing rings, shaft sleeves, packing and bearings.

The most important maintenance point on process pumping equipment is the stuffing box. It must be kept clean, cool, and lubricated—but *packing* is the crucial operation. A good packing method will be discussed in a later edition of *Pointers on Pumps*.

Don't forget the frames, base plates, and supporting parts of your pumps. Good housekeeping often makes it easier to do a good overall maintenance job!

Can We Help You?

Worthington makes more *standard* pumps than any other manufacturer. Don't buy a "special" (at a higher price) without checking to see if Worthington makes it *standard*.

If you *do* need a special, remember Worthington's modern engineering facilities, backed by the longest and broadest experience in the field. Contact our nearest District Office or write to Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.

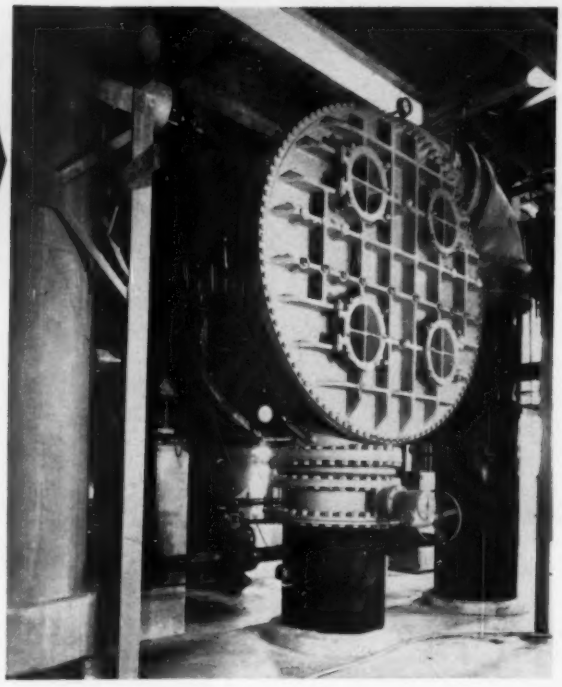
C.2.2

The World's Broadest Line Assures You the Right Pump for Every Job

WORTHINGTON

Centrifugal Pumps

Top Turbine Performance at Brazos River Plant Assured by CONSECO Condenser and Heater Unit



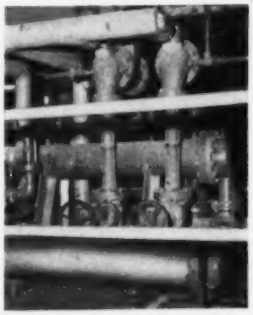
Heater Handles 123,000-lb. Feedwater Per Hour

Another example of the way Conseco Equipment helps step up central station performance is found at Brazos River, Texas, plant of Brazos River Power Transmission Electric Co-op.

Here a 14,000 sq. ft. 2 pass, non-divided flow Conseco Condenser, with horizontal type hot well and spring supports, handles a 11,500 kw. turbine.

As pictured in above photograph, a Conseco Feedwater Heater at left of condenser is a high pressure vertical unit handling 123,000 lb. of feedwater per hr., from 293 deg. to 362 deg. F at 800 psig extraction steam. Heater is fitted with cast-steel heads and is of the pull-through type.

Besides the high-pressure unit shown, this Conseco Feed Heating installation includes a low-pressure horizontal unit and an intermediate pressure vertical unit. Shown below at right, is the Conseco Air Injector installed at Brazos River. It is of the twin-element, two-stage type, with separate inter and after condensers.



Conseco Twin Element, Two-Stage Air Injector installed at Brazos River Plant, Texas

***CONSULT CONSECO ENGINEERS** about your condenser and feedwater heater needs. They will be glad to tell about the advanced features which assure trouble-free, low cost performance in your plant*

CONSECO LINE includes: BOILERS • CONDENSERS • STEAM AIR JET EJECTORS • DEAERATORS • CLOSED HEATERS

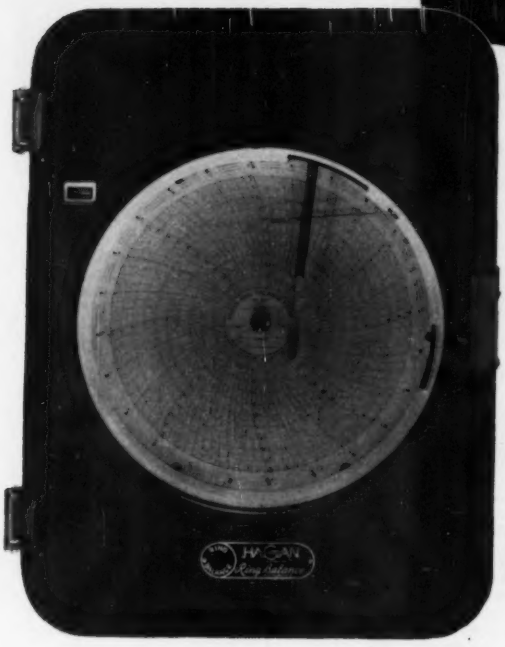
CONSECO

CONDENSER SERVICE & ENGINEERING CO.

HOBOKEN, NEW JERSEY

No stuffing box troubles in

HAGAN RING BALANCE METERS



because there are no stuffing boxes!

Forget about stuffing box troubles and pressure tight bearings when you install Hagan Ring Balance Meters. The simple, flexible S-tube connections to the ring assure dependable accuracy and trouble-free operation.

Features of the Hagan Ring Balance Meter include:

- **Calibration can be checked under operating conditions by check-weight method**
- **Excellent response at extremely low flow rates**
- **Mercury level not critical**
- **Full-scale chart differential is adjustable over a 7-to-1 range**

HAGAN CORPORATION

HAGAN BUILDING
PITTSBURGH 30, PENNSYLVANIA

Our engineers will be glad to show you how Hagan Ring Balance Meters can help solve your metering problems. Use the coupon, or write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

Hagan Corporation
Hagan Building • Pittsburgh 30, Pennsylvania

Please send me further information on Hagan Ring Balance Meters. I am particularly interested in .....

.....

NAME .....

POSITION .....

COMPANY .....

STREET AND NUMBER .....

CITY ..... ZONE ..... STATE .....

PE-2

FOSTER FLOW TUBE

FIVE FEA

for your Consideration:

1 . . . Compactness Note in the picture above the short axial length. Tubes 3" in size and larger are approximately 1 to 1½ diameters long, depending upon the velocity in the main. For high main line velocities (above 10 ft/sec. for liquids) tubes are less than 1 diameter in length.

2 . . . Ease of Installation Due to its compactness and because it requires no straight runs upstream or downstream, except near valves or regulators, the total space required for installation is but a small fraction of that necessary for other primary devices. It can be installed as readily as a fitting and in that section of the line most conducive to steady flow conditions. Moreover, it can be installed in the plant proper, eliminating the need for expensive vaults or housing.

3 . . . Reversibility The Foster Flow Tube is symmetrical transversely; upstream and downstream nozzles and ports are identical. This means that where processing calls for flow reversal, the meter can readily handle the changes.

4 . . . Low Head Loss Where head losses are important Foster Flow Tubes are designed with a main-to-throat ratio that provides negligible unrecovered head losses.

5 . . . Accuracy All Foster Flow Tubes are furnished with calibration curves obtained in laboratory tests simulating installation conditions and can therefore be guaranteed to an accuracy to meet any specification.

Foster Flow Tubes are recommended for a wide range of services metering the flow of liquids and wet or dry gases. They are available in all commercial pipe sizes with flanged or screwed connections. Standard lining is bronze but other materials are available. In writing for further information, give processing and installation details of your metering requirements.

FOSTER ENGINEERING

ST. LOUIS MUSEUM

(*Continued from page 61*)

ect, a good deal of which must be raised from outside the Museum and its membership.

Contributions, which are tax deductible, are sought from the engineering fraternity in particular. G. F. Kiesel, President of the Museum, has summed the situation up as follows, "Technological progress in engineering is so rapid that we are rapidly losing the landmarks of the past, by which our advances can be measured. All forms of transportation have attracted enthusiasts and even substantial organizations to preserve equipment and literature. We propose to do this in the field of stationary engineering as well."

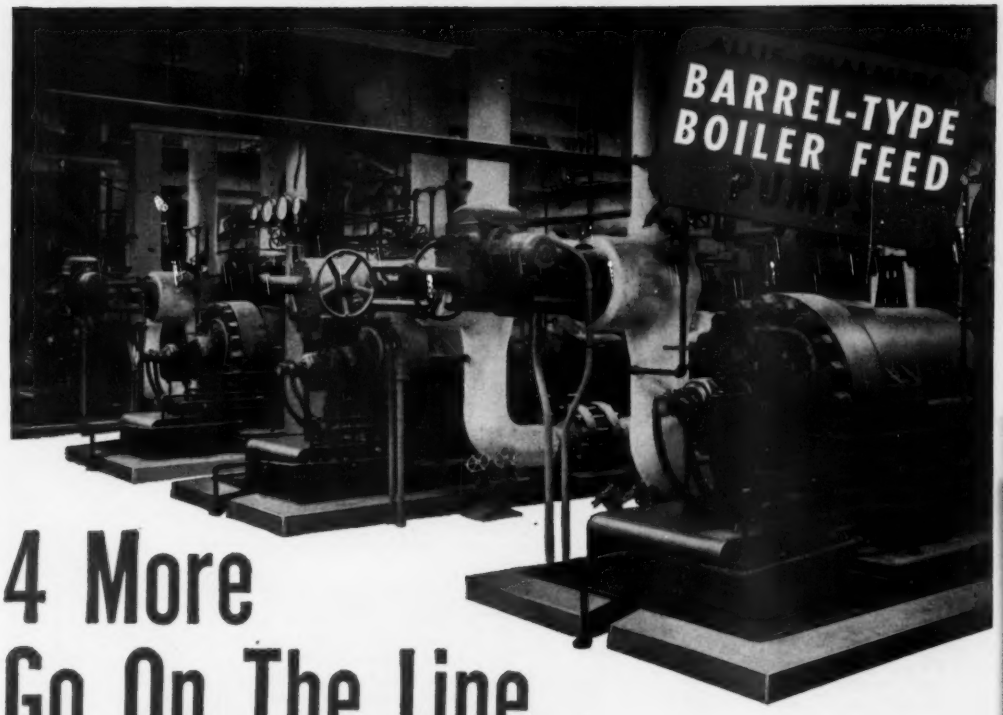
Members of the Museum were in New York in December working out details with Lipsett, Inc., Contractors, who have charge of the demolition of the old machinery. The Museum's attorney is working on an escrow agreement, whereby all funds collected will be administered by the St. Louis Union Trust Co. In event of oversubscription or abandonment of the project, the agreement will provide for the naming of alternate beneficiaries, recognized educational, charitable or religious organizations of the donor's choice, to whom the funds will go. The Museum does not wish to profit directly from this drive.

Individuals and firms who are interested in the project can obtain further information from the Secretary, The Museum of Steam & Marine Engineering, 3251 Hawthorne Blvd., St. Louis 4, Mo. Copies of the final escrow agreement should be available to prospective contributors at the time of this publication.

DR. FRANK MARTINUZZI, internationally-known authority on gas turbines, has been appointed to the faculty of Stevens Institute of Technology, Hoboken, N. J. Beginning with the spring semester Dr. Martinuzzi will teach both graduate and undergraduate work at Stevens. For the past two years he has been professor of mechanical engineering at Cornell University.

THIRD National Standardization Conference, sponsored by the American Standards Association, will be held in conjunction with the Centennial of Engineering in Chicago, September 8, 9, and 10, 1952, the ASA has announced. The conference will take place at the Museum of Science and Industry. The three-day series of meetings will emphasize the role of standards in the many technological advances during the past century.

The 34th Annual Meeting of the American Standards Association will be held at The Waldorf-Astoria, New York, November 19th, 1952. The Howard Coonley Medal and The Standards Medal will be presented at the Award Luncheon.



4 More Go On The Line

AT NEW HAWTHORN STATION, KANSAS CITY

Over 50 of these pumps have been bought by utilities on their proved performance record.

NEWEST PLANT OF KANSAS CITY POWER & LIGHT CO. is the Hawthorn Steam Electric Station on the Missouri River. This station, designed with every modern feature for dependability and low cost operation, has an initial capacity of 132,000 kw from two turbines and is already building an addition that will add almost another 100,000 kw from one additional turbine.

The boiler feed pump arrangement, pictured above, consists of four Allis-Chalmers 8" x 8" barrel-type boiler feed pumps with a capacity of 700,000 pounds per hour each at a discharge pressure of 1625 psig. They are driven by 1750 hp, 3600 rpm motors.

The unit now under construction also will be served by Allis-Chalmers barrel-type boiler feed pumps. Three pumps with a capacity of 425,000 pounds per hour at 1815 psig driven by 1250 hp, 3600 rpm motors are now being built.

Engineering Features

Unique engineering features designed to increase reliability and reduce maintenance have been proved in operation. Single-stage, back-to-back impellers balance axial forces without the use of a balancing drum. First stage has twin, half capacity impellers to give the advantages of low NPSH. Expansion joint is brought to the outside of the pump where leakage may be quickly detected and adjustments made without dismantling the pump. No flexible internal members are required to compensate for expansion.

Sizes range from 1200 to 3000 psig and from 300 to 2500 gpm. Allis-Chalmers can supply the complete boiler feed pump installation including pump, motor and control of coordinated design and manufacture.

Get the details on this modern-design, performance-proved boiler feed pump from your Allis-Chalmers District Office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3522

ALLIS-CHALMERS A-C ALLIS-CHALMERS

How to make packings last longer

Tips by Johns-Manville Engineers to help you keep production rolling

The old packing gives the clue to most packing failures...

I was ruined by shaft misalignment. When old packing shows excessive reduction in cross-section directly beneath rod, shaft or plunger, bad alignment is indicated. Leakage usually occurs around top of shaft or rod. Cause may be worn bearings which permit shaft to whip.

Too much gland pressure did me in. Badly deformed rings next to the gland follower, with bottom rings in fair condition, suggest excessive gland pressure or improper installation. Excessive gland pressure sometimes causes packing to extrude between follower and rod or shaft.

Lack of lubrication made things too hot for me. If the wearing faces of the rings are dried out or charred, with the rest of the packing in usable condition, the trouble probably is lack of lubrication. Excessively high operating temperatures and wrong type of packing can cause similar symptoms.

I'm worn out because I turned with the shaft. Unusual wear on the outside circumference of the packing almost always indicates one of two conditions. The rings may be binding on the shaft and rotating with it, or the packing is too loose in the stuffing box and moving with the rod.

Why you can count on Johns-Manville

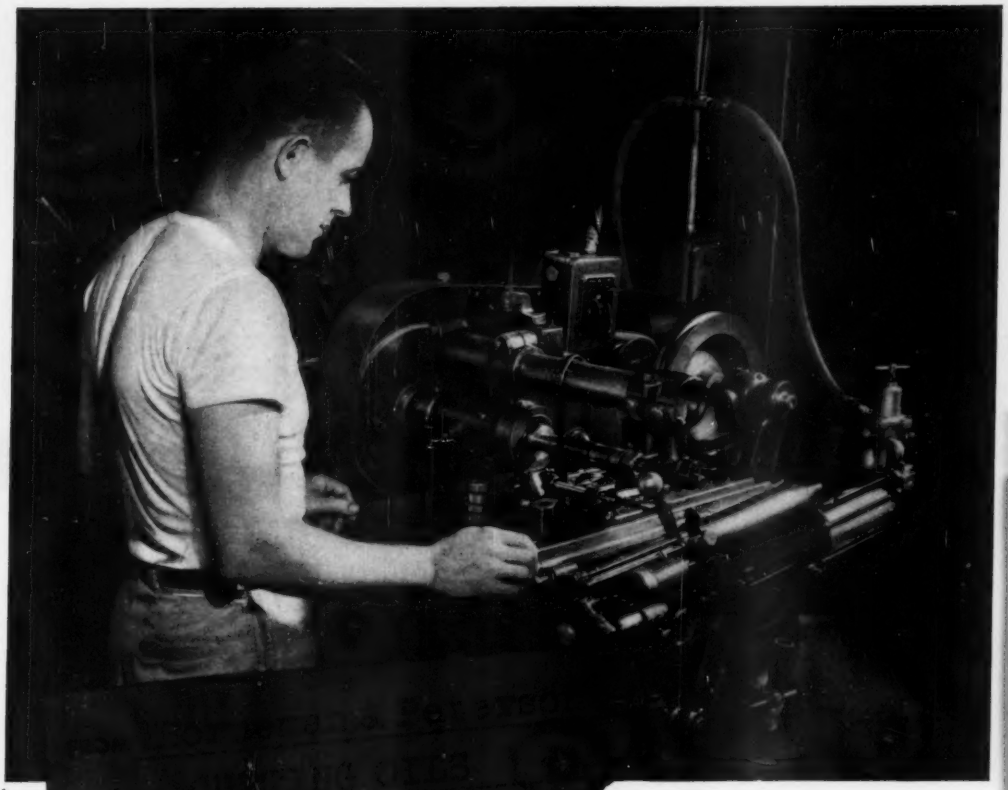
INTERLOCKED ROD PACKING

Because it's braided square, not braided round and pressed square, J-M Interlocked Packing lasts longer . . . has a better contact area . . . makes a tight seal with medium gland pressure. J-M Interlocked is recommended for both reciprocating and rotating service, for use against steam up to 500°F; hot and cold fresh and salt water; oils; weak acids and caustics.

Your distributor will help, too! Your J-M Packing Distributor can help you take the guesswork out of packing problems. He carries complete stocks of Johns-Manville quality packings and can supply you promptly. For the address of the J-M Packing Distributor nearest you, write Johns-Manville, Box 290, New York 16, N. Y. •

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS



ANY tiny production improvement looks big when it can be multiplied by acres of machines. But even without that—in an average size screw machine products shop like Borneman & Peterson's at Flint, Michigan—the improvement effected with Cities Service cutting oil registered impressively.

"We were getting fair results," write Borneman & Peterson, "before ever talking it over with a Cities Service Lubrication Engineer."

But they did talk it over, and then tried out his recommendation on a regular job of cutting ½" x 1" slots in tough tool steel. At once, the use of Cities Service Chillo cutting oil notably improved product quality.

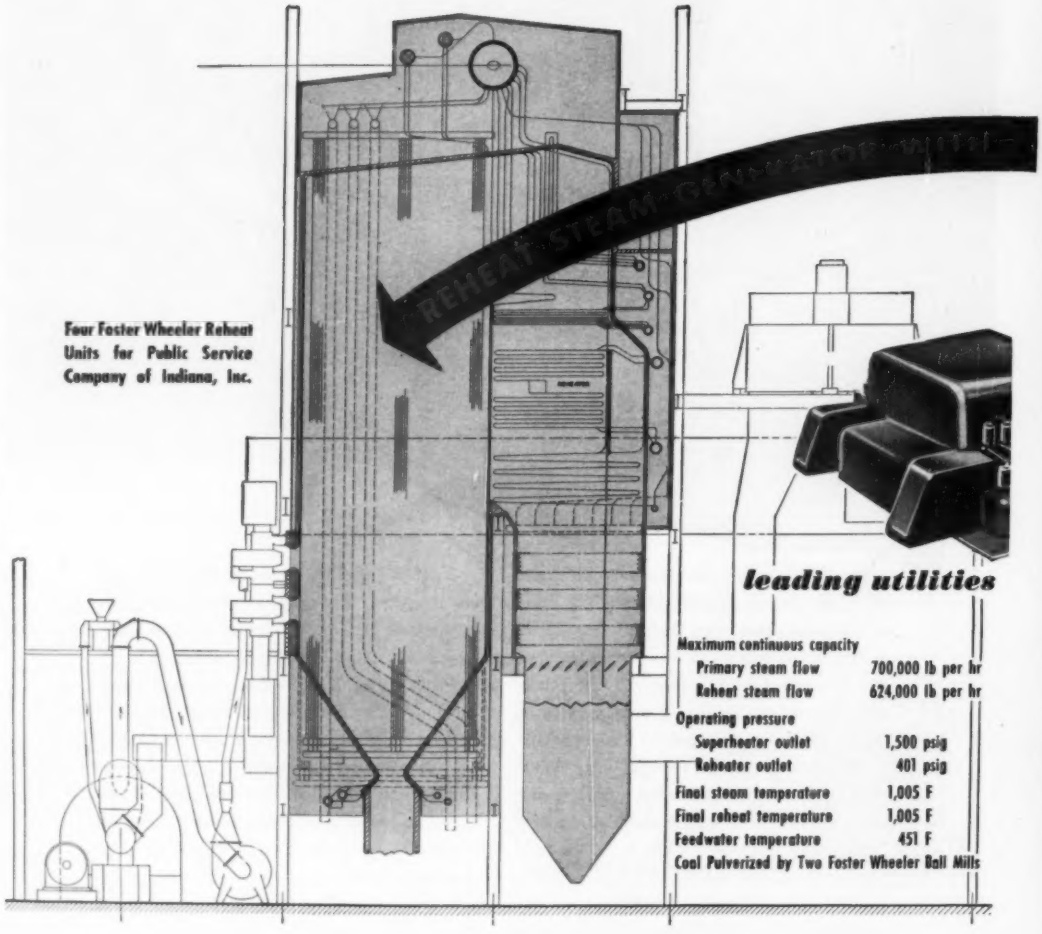
So..."We then tried using Chillo 10 on our threading machines, and found that not only do we get a better thread, but we have increased chaser life approximately 25%."

From there on, still more uses have kept turning up in this shop for Cities Service cutting oil, simply because it distinctly pays off...as it always does when a Cities Service Lubrication Engineer offers pinpointed lubricating recommendations. He draws on the c-o-m-p-l-e-t-e Cities Service industrial line, and on deep, wide experience. You can draw on *him* by writing CITIES SERVICE OIL COMPANY, Dept. B23, Sixty Wall Tower, New York City 5.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

Integrating

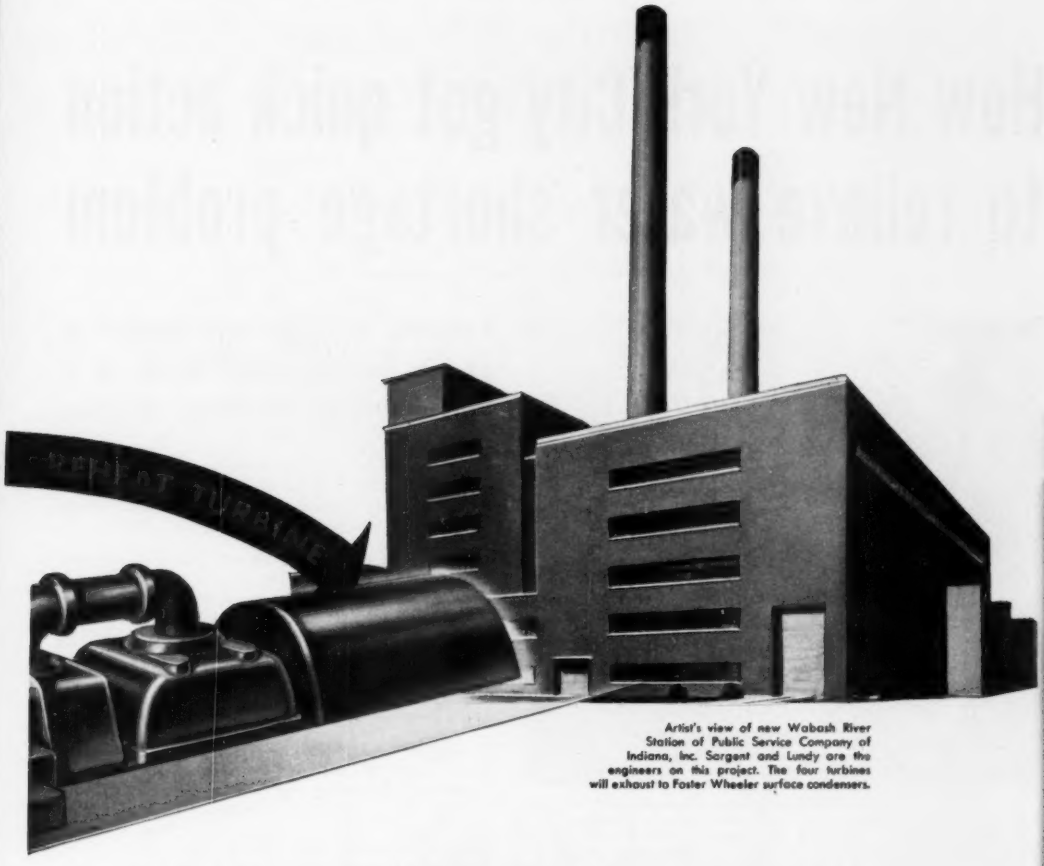


Four Foster Wheeler Reheat Units for Public Service Company of Indiana, Inc.

leading utilities

Maximum continuous capacity	
Primary steam flow	**700,000 lb per hr**
Reheat steam flow	**624,000 lb per hr**
Operating pressure	
Superheater outlet	**1,500 psig**
Reheater outlet	**401 psig**
Final steam temperature	**1,005 F**
Final reheat temperature	**1,005 F**
Feedwater temperature	**451 F**

Coal Pulverized by Two Foster Wheeler Ball Mills



Artist's view of new Wabash River Station of Public Service Company of Indiana, Inc. Sargent and Lundy are the engineers on this project. The four turbines will exhaust to Foster Wheeler surface condensers.

are ordering Foster Wheeler reheat steam generators

The large investment in present day power plant equipment dictates the careful selection of major components so as to avoid costly forced outages. Foster Wheeler engineers have always sought to refine the techniques of steam generation. They therefore took an early interest in the development of reheat where operating and control characteristics of the reheat boiler are integrated with those of the reheat turbine during every phase of service. Almost three decades ago, these engineers were responsible for the utilization of the characteristics of radiant and convection superheaters in series. Over "500 radiant superheater years" in one utility alone attest to the reliability of radiant surface for superheating.

The reheat steam generator illustrated is designed with a combination radiant and convection superheater and an all convection reheater. The chief advantages of this type of Foster Wheeler reheat steam generator may be listed as follows:

- complete freedom from furnace slagging is assured because furnace can be designed to suit fuel characteristics rather than reheat cycle duty requirements
- permissible wider selection of fuel of varying slagging characteristics
- location of the reheater deep in the convection zone assures safer metal temperatures during all starting, shutting down, and emergency operating conditions

This design also incorporates such features as:

- complete drainability of all superheating and reheating surfaces essential to quick and normal starts
- wide range of precise control of final steam temperature
- fully independent means of controlling primary and reheat steam temperatures.

These features provide for complete integrating of steam generating unit with turbine requirements under normal, quick start or emergency conditions.

FOSTER WHEELER CORPORATION • 165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

How New York City got quick action to relieve water shortage problem

Pumps operated by six G-E 2500-hp 4000-volt synchronous motors can supply 100 million gallons of Hudson River water daily. Station was designed as an emergency stand-by unit to operate only in event of water shortage pending completion of city's mammoth, war-delayed Delaware Aqueduct project.

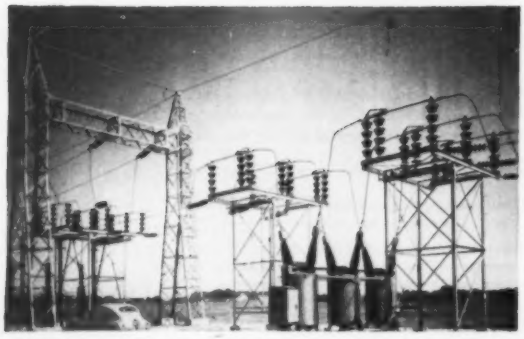
Speeds emergency pumping plant installation with G-E Standardized Outdoor Station

Speed and reliability were the watchwords when New York City decided to erect a Hudson River pumping plant to guard against a possible repetition of the 1949-50 water shortage.

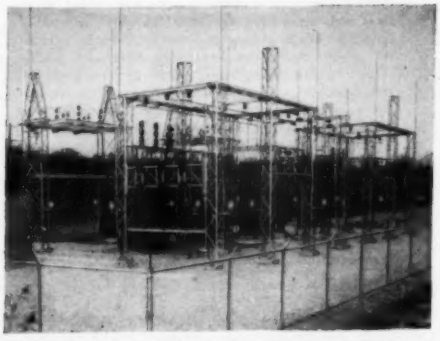
To operate the plant, a 15,000-kva outdoor substation was required. By deciding on a predesigned standardized substation, supplied as a complete package including the structure, New York City saved months of detailed engineering, cut delivery and installation time and had the station ready for operation within 9 months after signing the contract. What's more, taxpayers were saved money.

All motors, control and power substation equipment were co-ordinated by G.E. as a project—thereby saving more time since all responsibility for manufacturing and expediting was placed in the hands of one dependable manufacturer. *General Electric Company, Schenectady 5, N. Y.*

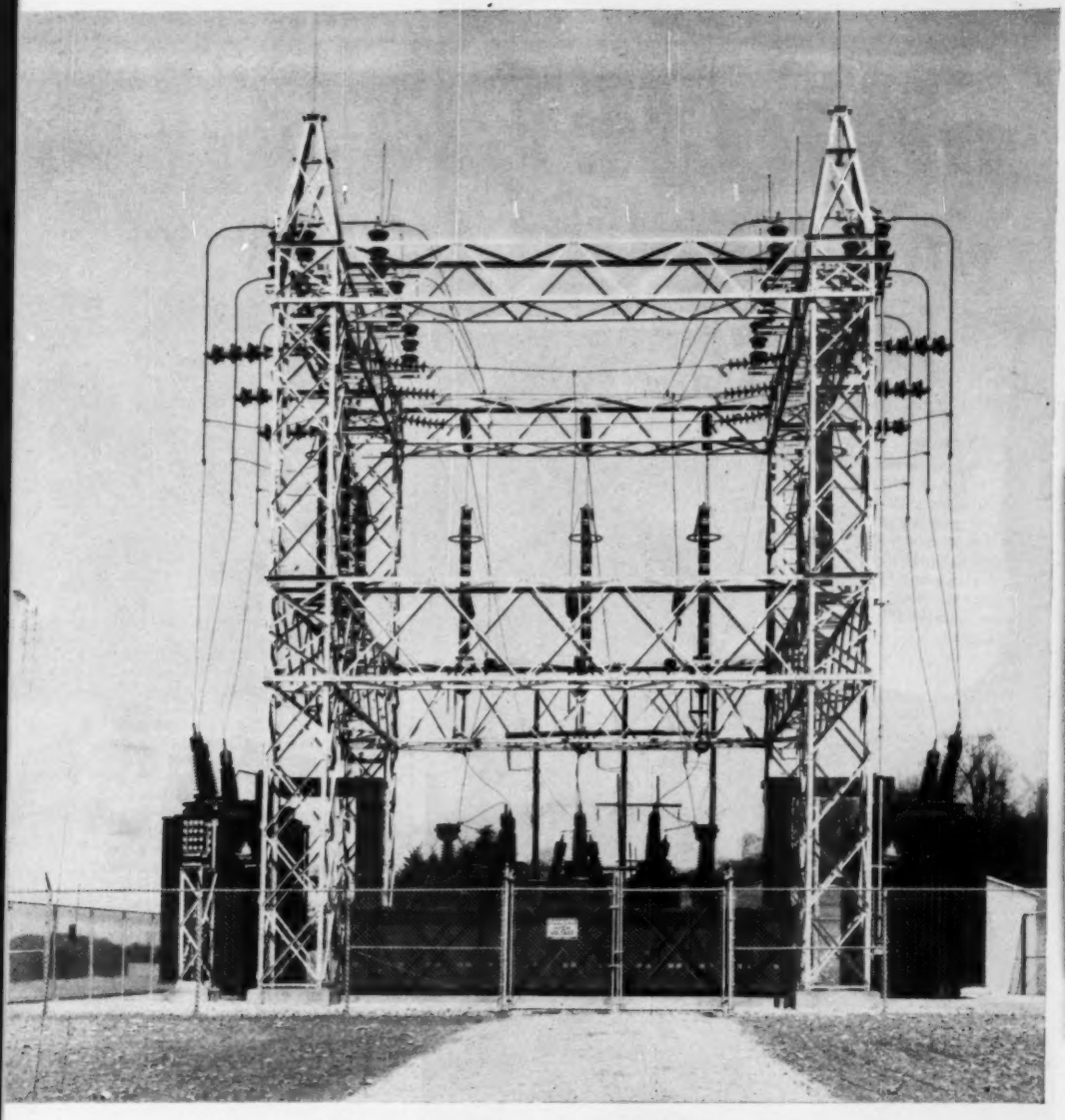
Standardization is modern trend for utilities, too



161-KV STATION erected by St. Joseph Light and Power Co., Marysville, Mo., is example of growing use of standardized equipment in electric utility expansion programs. Entire station, including steelwork, disconnecting switches, breakers, etc., was supplied by General Electric.



CINCINNATI GAS & ELECTRIC CO. MIDWAY STATION constructed entirely of G-E standardized units, including latticed columns and trusses. G-E standardized equipment is available for all ratings from 7.5 to 230 kv.



Everything Standard—including the structure

STANDARDIZED OUTDOOR SUBSTATION for Hudson River pumping station is rated 15,000-kva, 110-kv to 4.16-kv, 3-phase, 60-cycle. Includes two 7500-kva power transformers, outdoor circuit breaker and low voltage metal enclosed switchgear. Supplied as a "package," including standardized steel structure.

For information on similar equipment, write for Bulletins GEA-5573 Standardized Structures, GEA-1040 Power Transformers, GEA-4985, GEA-1642 and GEA-4407 Oil Circuit Breakers, GEA-4980 RF Disconnecting Switches.

GENERAL ELECTRIC

9154

ROTOJET®
TUBE CLEANERS

Give More Power
Use Less Air

More power with less air for a faster, more thorough tube cleaning job—that's what the new Rotojet offers. A Rotojet should save you enough in time, labor, and air on one cleanout to pay for itself. Send for Bulletin R-105 for full details.

THE SECRET

ROTOJET Motor has only two moving parts, a shaft and a paddle. Positive contact between paddle and Rotocentric (egg-shape) bore cylinder prevents stalling at low speeds. No leakage. Delivers maximum power for air used.

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Avenue, Newark 1, N. J.

SOMETHING NEW — A STATIC MAGNETIC EXCITER

(*Continued from page 63*)

nonlinear resonant circuit. The single-phase voltage for the energization of this circuit may be taken directly from one phase of the alternator, or it may be obtained from a circuit which produces the average voltage of the three phases of the alternator.

The nonlinear circuit consists essentially of a capacitor C, an iron-core reactor L, and a rectifier 2REC which energizes the control windings of the saturable current transformers. The current flowing in this nonlinear circuit is shown in Fig. 10 as a function of the applied voltage. In the vicinity of A, which is the operating region, a small change in the alternator voltage E causes a very large variation in the current I_c. If, for instance, the alternator voltage E increases, the current I_c in the nonlinear circuit rises sharply. This produces additional saturation in the saturable current transformers, resulting in a reduction of X_2, and hence in the desired reduction of field current I_f. In cases where the power output of this nonlinear circuit is not sufficient for its direct application to the saturable current transformers, a suitable magnetic amplifier may be interposed for this purpose.

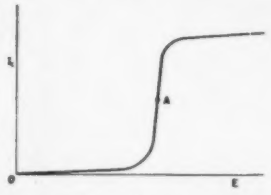
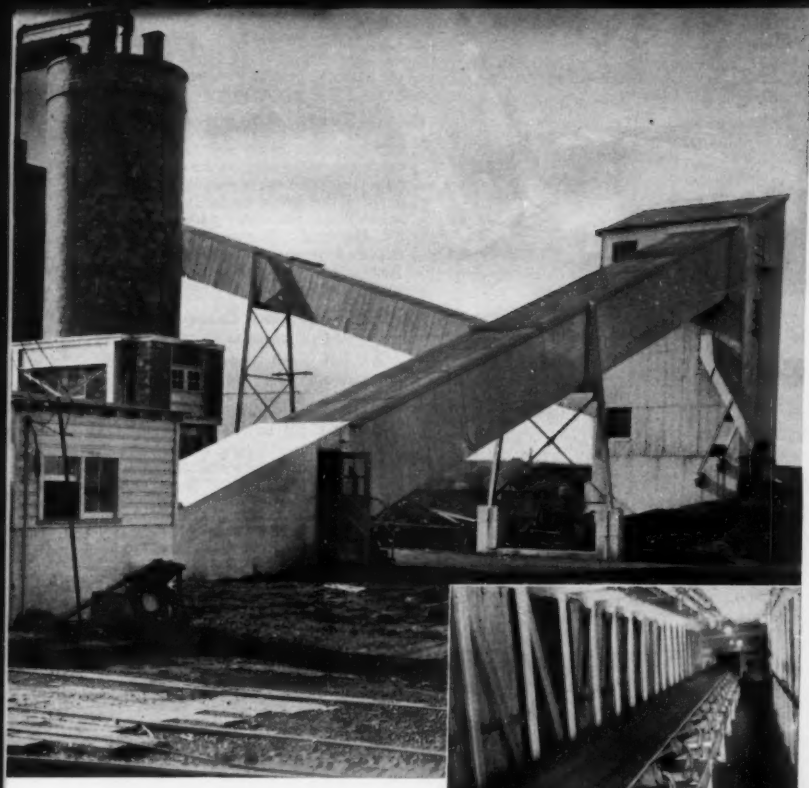


Fig. 10. *Current I_c of correction circuit as a function of alternator terminal voltage E*

Performance

This static exciter has been tested on a salient-pole alternator, rated as follows: 3-phase; frequency 420 cps; line-to-line voltage 220; rated current 730 amp: power factor 0.8, inductive; synchronous reactance 0.22 per unit; open circuit field time constant 0.25 sec; field current for rated alternator current 80 amp; field resistance at 25 C 0.805 ohm, at 90 C 1.03 ohms; air gap 0.091 in.; speed 1800 rpm.

The performance of the regulator was highly satisfactory both as regards steady-state accuracy, and transient response. When the alternator was suddenly called upon to provide half its rated load at a power factor of 0.4 inductive, the variation in generator voltage was as shown in Fig. 9. Within 310 milliseconds after the inception of the load, the alternator voltage was already within ± 1 per cent of the final sustained value. Another feature of this exciter system is its ability to maintain excitation under short-circuit conditions.



Starts fast at forty below...

This belt conveyor carries coal from railroad cars to overhead hoppers for a power company located in the northern part of the Midwest . . . so far north that temperatures frequently hit forty below zero. Starting the conveyor in that kind of weather meant lost time, wasted manpower. The bearing lubricant became so stiff that five or six men often were required to pull on the belt. Three hours a day frequently were lost in getting the unit in operation.

As many as a dozen conventional lubricants were tried without success before a change to STANOLITH Grease No. 42 was made on the recommendation of a Standard Oil lubrication specialist. None could match the ability of STANOLITH to provide easy starting at extreme low temperatures, and still maintain effective lubrication during high summer temperatures.

STANOLITH Greases are filling the bill in a wide range of industrial and processing applications because of their resistance to heat and to the washing action of water, and their ability to flow readily under wide variations in temperature. A Standard Oil lubrication specialist can help you take advantage of these special properties. A call to your local Standard Oil Company office is all that's necessary. Or write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANOLITH
TRADE MARK
Greases

What's your problem?

Meet R. R. Rowlands, of Standard's La Crosse office. He is the lubrication specialist who worked with this power company to find the right grease for an especially tough job. And as a result of his work, the company was able to save considerable time in the operation of a coal conveyor.

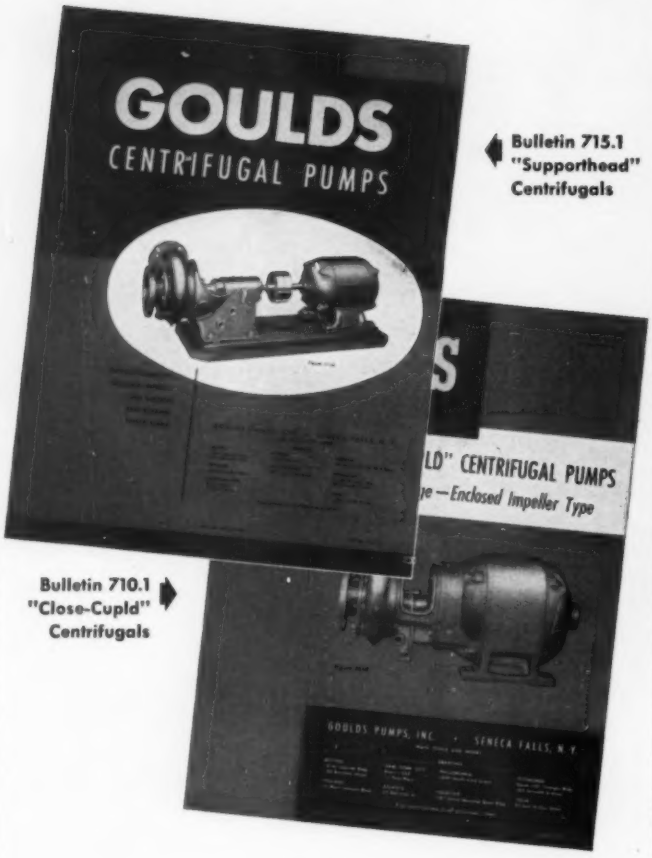
His on-the-job service is typical of that available to all midwest plants through a corps of such lubrication specialists. You can be sure that the specialist in your own area has both the practical experience and the training in a Standard Oil Lubrication Engineering School that will result in dependable, thorough assistance.

Why not call your local Standard Oil Company office today? Put a lubrication specialist to work on your problem now. When he calls, be sure to discuss the advantages and performance records of these outstanding products:

STANOIL Industrial Oils—This multi-purpose line of oils provides cleaner operation of hydraulic units, supplies effective lubrication in air compressors, gear cases, and circulating systems. One or two grades can replace a wide variety of special oils and lubricants.

CALUMET Viscous Lubricants—These greases strongly resist washing and throw-off. Their superior wetting ability affords better coating of open gears and chains, better internal lubrication of wire ropes.

STANDARD OIL COMPANY STANDARD *(Indiana)*



These new bulletins make it easier for you to select the right pump

These new bulletins have been designed to help you. New sizes are listed, and, in each bulletin we have put a composite rating chart which includes both "Close-Cupld" and the supporthead. This makes it dead simple to put your finger on the right pump for your requirements.

Another valuable feature of these bulletins is the parts chart. Using this you see exactly what parts are interchangeable for all size pumps and so can keep your spare parts investment to a minimum.

Use the coupon below to send for these useful FREE bulletins *today*. Goulds Pumps, Inc., Seneca Falls, N. Y.

PUMPS INC.
Goulds Seneca Falls New York

GOULDS PUMPS, INC.
Dept. PE, Seneca Falls, N. Y.
Send Bulletin 710.1 ☐
Bulletin 715.1 ☐
Name_____
Company_____
Address_____
City_____ Zone___ State____

RELATIVITY

(*Continued from page 67*)

cycle was found by subtraction, the decreases were plotted on coordinate paper, smooth curves were drawn for each of the seven cycles, and figures taken from these curves at 20, 40, 60, 80, 100 and 110 per cent of rated capacity were used for the decrease in Btu per kwh net station output in the final calculations.

Annual Fixed Charges on Investment Costs

Annual fixed charges were calculated at only two percentages, namely, 6 per cent and 12 per cent of the increase in investment cost for the cycles (2) to (8) inclusive over that for the 850-psig 900 F cycle. These fixed charges are assumed to include cost of money, depreciation and taxes.

Increase in Annual Maintenance Costs

Likewise, increases in annual maintenance costs were calculated on the basis of 1 per cent of the increase in investment cost for the cycles (2) to (8) inclusive over that for the 850-psig 900-F cycles. These were added separately because some engineers may use other figures obtained from actual experience.

Decrease in Fuel Costs

Fuel prices vary widely throughout the United States and, for the purposes of this article, decreases in fuel costs for the seven cycles (2) to (8) inclusive were calculated at four prices of fuels, namely, 20, 30, 40 and 50 cents per million Btu. These conform approximately to the following prices of coal, fuel oil and gas:

Price per Million Btu	Price per Ton of Coal @ 13,000 Btu per lb	Price per Bbl. Fuel Oil @ 6,250,000 Btu per bbl	Price per 1000 cu ft Natural Gas @ 1100 Btu per cu ft
$0.20	$ 5.20	$1.25	$0.22
0.30	7.80	1.875	0.33
0.40	10.40	2.50	0.44
0.50	13.00	3.125	0.55

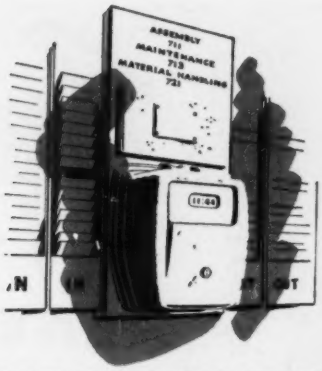
Sample Calculation Sheet

A sample calculation sheet for the final results is shown in Table II which is self explanatory. It demonstrates the directness and simplicity when all calculations are based directly on differences.

Results

The results are shown graphically in Figs. 1 and 2, which speak for themselves. The numbering system makes it easy to trace each curve and compare it with the others, and the fact that they record *differences* in costs per kwh makes it possible to use a larger scale and causes the curves to cross each other at clear cut angles. The author wishes again to call attention to the fact that relativity is the key word in interpreting these curves and will indulge in only three uninhibited remarks:

1. The good old 850-psig 900-F straight regenerative cycle is still the



A BOILER THAT PUNCHES THE TIME CLOCK

Yes — a Cleaver-Brooks Boiler "Punches In" to meet a heavy steam demand — "Punches Out" during low load periods.

Steam costs can eat deeply into profits when steam loads fluctuate — or are intermittent. With a Cleaver-Brooks boiler you are equipped for heavy or light . . . steady or variable loads, operating at full 80 per cent efficiency over the entire working range of the boiler.

You are assured of fuel economy through high heat transfer. *All* Cleaver-Brooks boilers are of the four pass design and the maximum useable heat is absorbed in these four passes before the combustion gases leave the boiler.

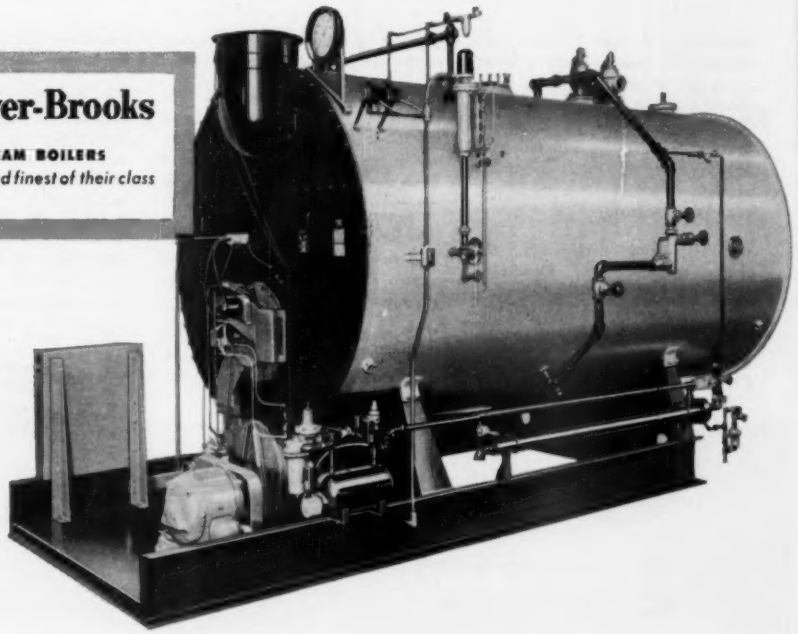
Remember the name Cleaver-Brooks if you are considering a change in your present boiler plant. Think about flexibility and get the complete facts about Cleaver-Brooks Self-Contained Boilers — standard models in 15 to 500 HP, 15 to 250 psi, oil, gas, combination oil and gas fired — 80 per cent efficiency.

CLEAVER-BROOKS COMPANY
Dept. B-510, E. KEEFE AVE., MILWAUKEE 12, WIS.
Builders of Equipment for the Generation and Utilization of Heat • Steam Boilers • Oil and Bitumen Tank-Car Heaters • Distillation Equipment Oil and Gas-Fired Conversion Burners

Cleaver-Brooks

STEAM BOILERS
the first and finest of their class

Write for the latest graphically illustrated Cleaver-Brooks Boiler Catalog. It tells and shows how you can save money with a Cleaver-Brooks Boiler installation.



American

JET TRAY DEAERATOR

The Only New Idea in DEAERATION in the PAST DECADE!

American's System of Jet Tray Deaeration combines the proven processes of a water spray type direct contact first stage heater (where substantial gas removal occurs), a steam jet atomizer and a multiplicity of wetted wall mass exchange towers in a third gas separating section.

Uniquely and exclusively, the American Jet Tray Deaerator utilizes the slightly higher pressure and correspondingly slightly higher temperature of the incoming steam in indirect heat transfer relation with the last deaerating process to increase the efficiency of the wetted wall surfaces.

A liquid seal between the first heating and gas removal stage and the later deaeration stages prevents highly contaminated vapors from the first stage contacting the water in the deaeration stages.

The design of this interstage water seal provides automatic compensation for vapor pressure losses through the system.

The wetted wall deaeration section contains more surface area, and provides greater vapor turbulence and water agitation than any other tray deaerator made.

The American Deaerator has the capacity to thoroughly deaerate under the most difficult conditions and establishes an improved standard of performance in the industry.

Your inquiry for authoritative advice involves no obligation... may we offer our experience to your deaeration problem?

CELEBRATING OUR FIFTIETH YEAR!

AMERICAN SYSTEM A W S C PATENTED

The **AMERICAN WATER SOFTENER COMPANY**

LEHIGH AVENUE & FOURTH STREET • PHILADELPHIA 33, PENNA.

FILTERS • SOFTENING SYSTEMS • CHEMICAL FEEDERS • ION EXCHANGERS • RE-ACTORS • SWIMMING POOL EQUIPMENT • DE-GASIFIERS • WATER TEST SETS • RE-CARBONATORS • ALKALIZERS

favorite for low annual capacity factors, particularly when combined with low fuel prices.

2. The highest pressure and temperature cycles, both straight regenerative and reheat regenerative, are represented by curves having steep slopes and appear to be justified only by very high annual capacity factors and high fuel prices.

3. But keep your eye on the moderate pressure and temperature cycle as exemplified by the 1450-psig 1000/1000-F reheat regenerative cycle — it appears to have everything!

DEATH OF H. C. CARROLL

H. C. CARROLL, member of the consulting engineering firm of Carroll, Bechtel & Langtry of Chicago, died of a heart attack on December 25, 1951, at his home in Evanston, Illinois. He was 71 years old.

Mr. Carroll was well known to many POWER ENGINEERING readers as a consultant on fuels, fuel testing and general power plant design and operation. He

was a member of ASME, and an active member of the Society's Boiler Code Committee. He was a licensed professional engineer in Illinois, Indiana, Michigan and Wisconsin.

Since 1927, Mr. Carroll has been Director of the Mechanical Engineering Department of Commercial Testing and Engineering Co. of Chicago. In 1949, that company established a separate division to handle its consulting work and Mr. Carroll and two other members of the testing company, Messrs. Bechtel and Langtry, have carried on that enterprise ever since.

Mr. Carroll was graduated from Cornell University in 1903 as a mechanical engineer with the degree of M.E. He then served for 5 years with Westinghouse Machine Co.

From 1908 to 1910 he was design and construction engineer for the Wabash Valley Traction Co. and from 1911 to 1913 chief operating engineer for the Indianapolis, Terre Haute & Eastern Traction Co., in direct charge of the 25,000-kw West 10th Station. He then served from 1913 to 1917 as superintendent of power for Indiana General Service Co., Muncie Division, American Gas & Electric Corp. He was chief engineer of Kentucky Avenue Station, Indianapolis Light & Power Co., 1917–1918, assistant superintendent of Construction and Operation, U. S. Nitrate Division No. 2, Alabama Power Co., 1918–1919 and later superintendent of operation. From 1919 to 1922 he was superintendent of power for Merchants Heat and Light Co. at Indianapolis.

In 1922 to 1927, Mr. Carroll engaged in private consulting engineering practice in Indianapolis and in 1927 joined Commercial Testing & Engineering Co.

How to look at 500 lbs. of steam *safely*

Safeguard your eyes from scalding steam and flying glass. Watch your water level safely through SONDERGLASS, the safe gauge glass. Virtually two tubes in one . . . the outer hardened to resist cold drafts and erosion . . . the inner to withstand great heat.

Sonderglass has been dipped into 450°F oil and repeatedly plunged into cold water without spalling or cracking.

Today, equip your boilers with the safe glass — Sonderglass — and enjoy the satisfaction of knowing that you have the best.

SONDERGLASS

THE SAFE GAUGE GLASS

PACKING Chesterton GASKETS

A. W. CHESTERTON CO.
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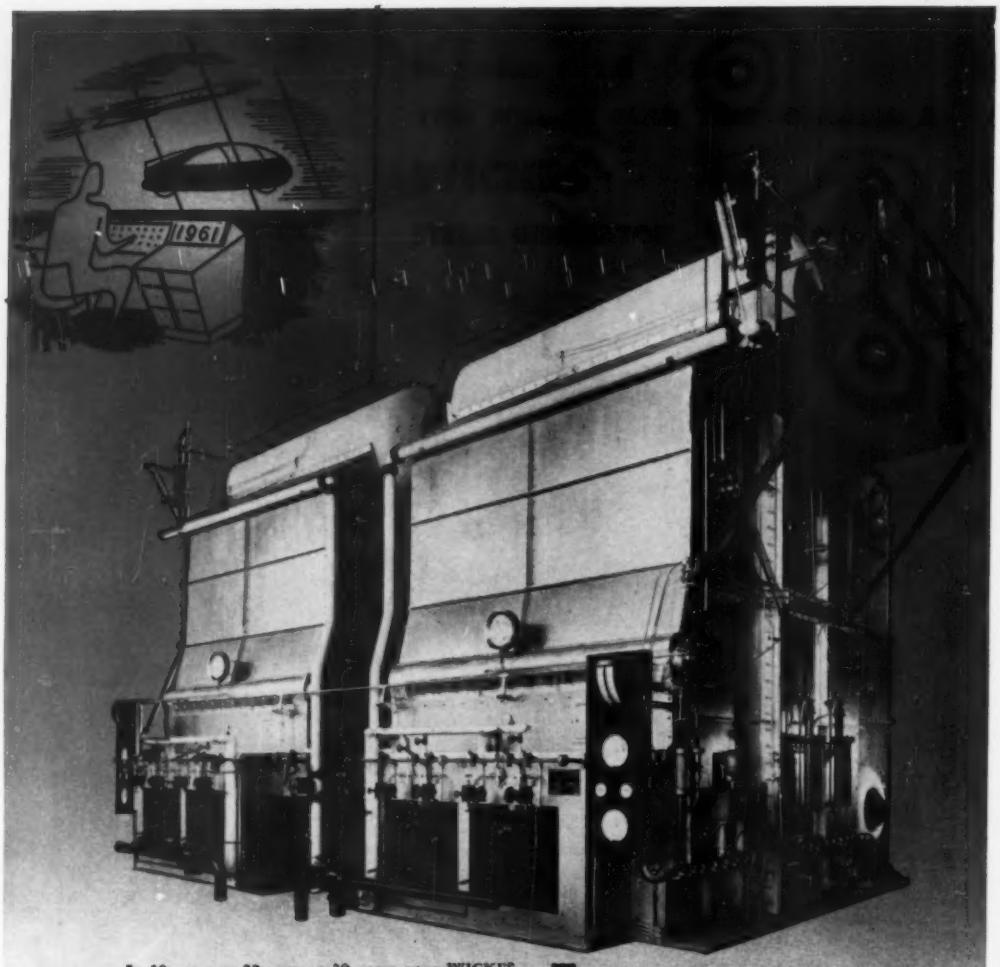

In 10 years or 20 or even 30 years, your WICKES Boiler will still be going strong. For almost a century now, The Wickes Boiler Company has been leading the field in the manufacture of efficient high-pressure water tube boilers that are really built to last. Throughout the world, industries that depend on steam have learned by long experience that they can depend on WICKES Steam Generators. The Type S 2-Drum Boilers shown here have found wide acceptance in the chemical processing industry because they *are adaptable to any standard method of firing* — oil, gas, single retort underfeed or spreader stoker. Each of these Type S Boilers is capable of delivering 35,000 lbs. of steam per hour. And the low head design makes them especially practical where space is limited. WICKES can fill your requirements for steam generators up to 250,000 lbs. per hour and 950 lbs. per square inch. If you have a boiler problem, our knowledge and experience *is available to you without obligation* . . . write today for descriptive literature on WICKES' complete line of steam generating equipment.

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New ENGINEERING BOOKS

The Handbook of Measurement and Control, edited by M. F. Behar; First Edition; hard-bound; 8¼ by 11¼ in.; xvi plus 291 pages; illustrated; published by Instruments Publishing Co., 921 Ridge Avenue, Pittsburgh, Pa. Price $4.00.

Feature of this book is that although every class and type of measuring instrument and of automatic-control device is described adequately, explained fully, and illustrated diagrammatically, commercial products are neither pictured nor even named in the text. Each chapter describing the methods of measuring and controlling a particular condition is followed by advertising pages, in which a number of instrument companies describe their respective commercial embodiments of the methods described in the immediately-preceding text.

The book consists of two halves: the first half original and unparallelled; the second half consisting of chapters on specific subjects which are treated in other books. Thanks to the first half, this book is the first one — so its publisher claims — in which the old-new science of measurement-and-control is adequately presented.

The first part of the book shows how instrumentation interlocks with the fields of observation, measurement, transmission, control and analysis. This is followed by sections on thermometry, pyrometry, automatic control of temperature, flow rate measurement and control, positive liquid and gas meters, pressure and vacuum, speed measurement and control. There is a chapter on instrumentation for chemical analysis and control, one on determining physical properties and testing finished products. These are followed by chapters on electrical instruments and regulators, dimensional gaging and inspection, control valves and their application, instrumentation in research, aviation instruments and nucleonics instrumentation.

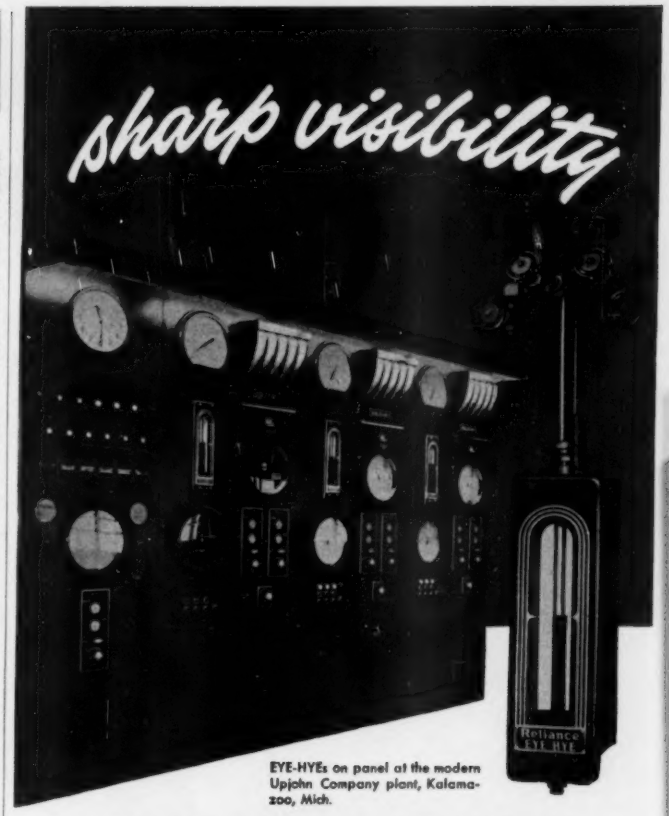
All the chapters on details are written by men well known in the various fields, while the introduction is by the editor.

Although many books on instruments and controls have appeared in recent years, there is nothing quite like this information all assembled in one place. The science of measurement and control is advancing very rapidly and every engineer who has anything to do with it must understand not only the basic principles but the latest developments of details. He will get them from this book.

Fuel Oil Manual. By Paul F. Schmidt. First edition. 6 by 9 in., illustrated, 160 pages. Semi-flexible binding. The Industrial Press, 148 Lafayette Street, New York, N. Y. 1951. Price $3.50.

Readers of POWER ENGINEERING who followed the series of articles on fuel oil characteristics by Paul F. Schmidt which we published between April 1950 and May 1951 will be pleased to know that all this material together with additional data can be found between the covers of this book. This manual is intended for those who buy, use, or sell fuel oil. Written by a chemist with many years experience in the industry, it provides a working knowledge of fuel oil and how to use it.

In this book Mr. Schmidt gives complete data on the properties of fuel oil, the possibilities and limitations of each grade of oil, methods which can be used to assure uni-



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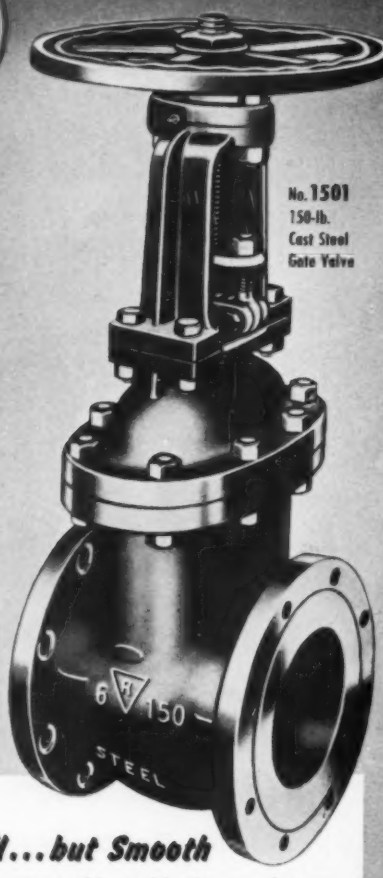

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form quality and efficient combustion, how to diagnose fuel oil troubles and how to remedy them. In short, it tells you how to get maximum value from each fuel-oil dollar. Under troubles and remedies are listed 22 of the common fuel oil troubles, their symptoms, and the remedy to apply in each instance.

The text, which includes 34 tables, is divided into 24 chapters covering chemistry of petroleum, petroleum refining processes, grades and types of fuel oils, gravity, heat of combustion, viscosity, water and sediment, carbon, ash and salt residue, flash and fire points, pour point, sulfur, color, distillation, preheating of oils, sampling storage tanks, stability of fuel oils, fuel oil treatments, reclaimed fuel oils, blending of oils, transportation and storage, fuel oil specifications, and complaints and causes of troubles.

Power Station Chemistry 1951, A report of the Power Station Chemistry Subcommittee of the Prime Movers Committee, Edison Electric Institute; 20 pages; illustrated; size 8½ by 11 in.; paper binding; published by Edison Electric Institute, 420 Lexington Avenue, New York 17, N. Y. Price $0.50 to members, $1.25 nonmembers, $1.35 to foreign countries.

This publication includes a statement of the subcommittee on each division of the subject, followed by summary of replies to questionnaires sent to member EEI companies on various subjects, and various statements from operating companies.

The first subject is chlorination practices, discussion of treatment methods with tabulation of answers to the questionnaires and discussion of the method.

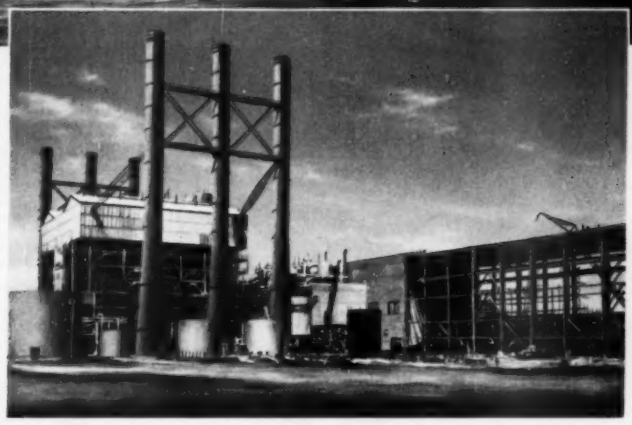
Next, experience with potassium boiler water treatment is reported by five leading utility companies.

Following this there are chapters on caustic washing of turbines, turbine lubrication and corrosion and failure of boiler handhole gaskets and handhole cap and seat-metal corrosion. The final section deals with laboratory and field testing of inhibited reclaimed insulating oils.

Synchronous Machines — Theory and Performance. By Charles Concordia. First Edition. 6 by 9 in., 224 pages, illustrated. Cloth. John Wiley & Sons, Inc. 440 Fourth Ave., New York, N. Y., 1951. Price $5.50.

This new book by Charles Concordia of the General Electric Company is intended largely for the practicing engineer who wants to learn something about the transient theory of synchronous machines. It is an excellent book for those who have adequate skill in the use of engineering mathematics, and combines in one book material which heretofore has been scattered through the literature. Those familiar with the literature of synchronous machines will realize the importance of having practically everything known about the subject between the covers of a rather small but intensely compact volume. As the author points out, it is not a text book, even though formulas for many specific purposes can be found in it. Rather, it is intended to be read as a whole from the beginning.

The volume presents a unified development of the fundamental circuit theory of the transient performance of synchronous machines as currently used by engineers directly concerned with the prediction of machine performance. The material was written for a synchronous machines course that has been given at the General Electric Co for the past three years. The emphasis is on a fairly rigorous mathematical development and obtaining a physical under-



DESIGN FOR EXPANSION

The unit system of construction for steam power plants is the most economical when possible future expansion is contemplated. The first three 100,000 kw units with three 7,500 kw condensing house units of Pacific Gas and Electric Company's new Steam Station at Moss Landing, California, were completed in 1950. An extension including two additional units, embodying still greater refinements for operating efficiency, was authorized almost immediately. These units will be placed in service late in 1952 and will increase the nominal capacity of the station to 522,500 kw.

The entire plant was designed and is being constructed by Stone & Webster Engineering Corporation in collaboration with the Pacific Gas and Electric Company's Engineering and Purchasing Departments.

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2. **PRACTICALLY INDESTRUCTIBLE NUT AND ENDS**
   The nut of a Dart and both ends are constructed of high test, air refined malleable iron. You get peak resistance to stress, stretching and wrenching.
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standing of synchronous machines. Thus, the reader will be equipped to extend the theory as he needs it and to attack new problems as they arise. A valuable feature of the book are the problems the author gives at the end of each chapter. The book has a good list of references and an excellent bibliography.

As already mentioned, Mr. Concordia's book demands a fairly good background knowledge of the subject and a familiarity with the use of ordinary differential equations, and operational calculus. Also a working knowledge of the theory of symmetrical components, and the per-unit system of representing machine and power system parameters.

The author is probably well known to most of those who can use this book. He is a graduate of General Electric's 3-year Advanced Engineering Program, having been with the company since 1926. He has had much experience in applying synchronous machine theory to the solution of various machine problems.

Defense Without Inflation, by Albert G. Hart; 186 pages; size 5 by 8 in.; cloth binding; published by the Twentieth Century Fund, 330 W. 42nd Street, New York 18, N. Y. Price $2.00.

The first eight chapters of this book, which analyze the main factors involved in paying for our large defense program with endangering our civilian economy through ruinous inflation, were written by Albert G. Hart, Professor of Economics at Columbia University. Counseling closely with him in the preparation of these chapters were the members of the Committee on Economic Stabilization, who add their own recommendations for action in a final chapter.

The Committee says that adequate national defense and higher living standards are both within the realm of possibility — that is, if Americans are willing to accept a realistic program involving personal sacrifices and reduced consumption in the initial stages of rearmament. Chief immediate needs, these economists hold, are pay-as-you-go taxation, limitation of bank credit, and a truce on customary contests of bargaining power and pressure among the interest groups.

Because every American citizen is now personally concerned with this subject and every engineer is also a citizen, he should read the procedures recommended in this book to see whether or not he agrees with them. Even if he does not, he may be forced by circumstances to accept them. The report describes the probable effects on business and on the individual citizen of measures which may be taken to meet the present emergency. The book will help the reader foresee and plan for the difficult days ahead. Yet if certain measures are carried out wisely, even under the strains of major defense outlays, we can keep our economy healthy, and maintain and even improve our standard of living.

Applied Nuclear Physics by Ernest Pollard and William L. Davidson. Second Edition; 352 pages; illustrated; 6 by 9 in.; cloth; published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y.; price $5.00.

To those who have been interested in the subject of nuclear physics for a period of ten years or more, this new edition of Pollard and Davidson's book will be very welcome. For many years this book was one of the few textbooks available on the subject and it was always one of the best. The First Edition appeared in 1942 during

(*Continued on page 140*)

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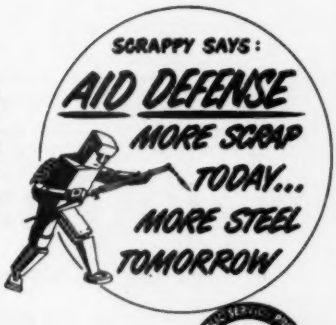

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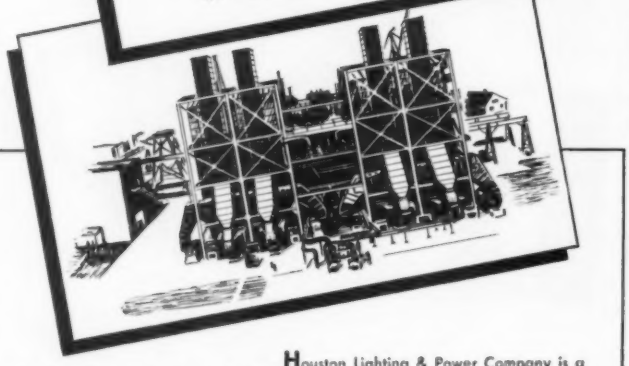

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HELPFUL BULLETINS

(*Continued from page 36*)

the welding of various metals. Presents up-to-date condensed information on recommended electrodes for the welding of mild steel, stainless steel, low hydrogen-low alloy steels, low alloy-high tensile steels, cast-iron, bronze, other metals. General Electric Co.

131 Fusion Welding Text — Technical Bulletin T-2 is a 44-pp treatise on the fusion welding of nickel and high nickel alloys; it includes more than 30 tables, almost 50 drawings and photos. It covers various forms of electric arc welding as well as gas welding, and besides giving detailed instructions it includes information on the ASME boiler code, and pickling, testing and inspection safety methods. The International Nickel Co., Inc.

132 Welding Rods and Procedures — Publication B-13 is a 24-pp new edition of company's booklet giving the applications and procedures for production and repair welding, and for building up worn surfaces with bronze rods. Welding techniques discussed include the oxyacetylene torch, metal-arc, carbon-arc and inert-gas-shielded arc. U. S. Navy and Federal specifications as well as other tabular data on copper and copper alloy welding rods are included. The American Brass Co.

MAINTENANCE

133 Metallizing for Maintenance — Bulletin 54A, 8 pp, illustrates some of the many ways in which metallizing saves money on maintenance jobs. Covers reduced replacement costs, reduced repair time, increased wear resistance, better lubricating, other advantages. Metallizing Engineering Co., Inc.

134 Fast Setting Cement — This illustrated folder describes Por-Rok, a pourable cement for quickly and permanently setting anchor bolts, repairing concrete floors. Gives instructions for use, test data. The Hallemite Mfg. Co.

135 More Holes in a Hurry — Form 2400 is a 36-pp pocket-size booklet which not only provides ordering information on manufacturer's drills, but also gives some excellent tips on how to get the most service from portable electric drills. Discusses motors, drill cord, drill chuck, right and wrong drill bit grinding, drilling of various materials, and drill maintenance. Includes tables of tap drill sizes, drilling speeds, other data. Mall Tool Co.

136 Floor Maintenance Products — This attractive 6-pp folder presents a condensed, over-all view of manufacturer's floor machines and attachments and floor cleaning preparations and replaces several single-sheet bulletins on the various products. Complete with application information, specifications, necessary instructions; stresses advantages of the various items. Multi-Clean Products, Inc.

OTHER EQUIPMENT

137 Heating, Air Conditioning Book — Bulletin PB-290, 36 pp, is the first complete, condensed catalog covering company's full line of air conditioning, heating, ventilating and heat transfer equipment to be published in five years. Supplements some 40 specialized bulletins on various product lines. Presents terse descriptions, cutaway drawings, photos, construction features and tables of capacities, sizes, dimensions. Recent developments featured include the CenTra-Vac hermetic centrifugal water chilling units. The Trane Co.

138 Improved V-Belts — Bulletin 6868-E describes the "precision balanced" and "more grip, less slip" features of company's Condor V-belts. Construction features, based on new precision-control methods and stronger materials, are explained. Installations are shown, and a table of standard sizes and list prices included. Manhattan Rubber Div. Raybestos-Manhattan, Inc.

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139 Noise Elimination — Industrial noises and their control are discussed in this new pamphlet. Shows principle of noise measurement, and how these noises are related to the human ear. Covers types of industries that can profit from control of disturbing noises, including those of power plants, manufacturing plants, and of such equipment as air conditioning systems, compressors, diesel engines, generators. Industrial Acoustics Co.

140 Turbine Oil Conditioning — Bulletin 832-P, 12 pp, offers a detailed explanation of the reasons for turbine oil conditioning, the way in which company's dry type conditioning equipment nullifies or prevents factors which promote deterioration of oil, and the question of system efficiency as affected by circulation rate and system capacity. Fully illustrated, tells how system works, describes equipment, some typical methods of installation. Includes dimensions. Bowser, Inc.

141 Axial Flow Blowers — Described in this bulletin are compact, axial flow positive pressure blowers for handling gas or air under pressure or vacuum. Shows sectional view of the blower, detail of main and gate rotor assembly. Tells applications, advantages of the blowers, includes specifications, capacity data. Blower-Stoker Div., Read Standard Corp.

142 Economical Arch Nosing — Bulletin 751 describes a simple but ingenious methods of building nosings for almost any type of heating furnace or fantail nosing of open hearth furnaces. According to bulletin this is a standardized nosing using universally adaptable castings, a minimum number of refractory shapes, minimum headroom, and affording maximum space for air cooling. Geo. P. Reintjes Co.

143 Tank Capacity Chart —This handy chart is for quickly figuring the number of gallons of a liquid in any horizontal tank without the use of tables, formulas or computations. Chart and explanation are printed on letter-size card suitable for wall, desk or file folder. Armstrong Machine Works.

144 Continuous Weighing Feeder — Bulletin 35–F5B describes company's Belt Gravimetric feeder for the continuous weighing and feeding of dry materials at capacities from 100 to 100,000 lb per hour. Lists features of the feeder, describes operation of major parts, illustrates mechanism. Omega Machine Co.

145 Belt Conveyor Idlers — Bulletin 51–81, 42 pp, contains information on latest designs and developments of company's belt conveyor idlers and machinery. Includes general engineering information helpful in designing and specifying belt idler equipment and cross-section drawings of both steel and cast gray iron idler rolls. New data on a return belt training idler is given, together with material on newly-developed steep-angle troughed belt idlers and steep angle troughed belt self-aligning idlers. Information on lubrication material and techniques is provided; correct maintenance procedure is also presented. Chain Belt Co.

146 For Fuel Flexibility — Form AD-101 descibes a gas and combination oil and gas burner that's fast heating, clean, economical, and affords quick changeover of fuels. Illustrates several models, stresses advantages, discusses safety and combustion controls. Includes ratings and capacities. Cleaver-Brooks Co.

147 Extinguishers and How to Use Them — A good refresher course on modern fire-fighting devices and the different fire extinguishing agents used in them is contained in "Correct Fire Protection," a 32-pp illustrated booklet. Illustrates and describes various sizes of units available for use with different kinds of extinguishing agents. American-LaFrance-Foamite Corp.

BUSINESS IN MOTION

To our Colleagues in American Business . . .

For several years this space has been used to tell how Revere has collaborated with its customers, to mutual benefit. Now we want to talk about the way our customers can help us, again to mutual benefit. The subject is scrap. This is so important that a goodly number of Revere men, salesmen and others, have been assigned to urge customers to ship back to our mills the scrap generated from our mill products, such as sheet and strip, rod and bar, tube, plate, and so on. Probably few people realize it, but the copper and brass industry obtains about 30% of its metal requirements from scrap. In these days when copper is in such short supply, the importance of adequate supplies of scrap is greater than ever. We need scrap, our industry needs scrap, our country needs it promptly.

Scrap comes from many different sources, and in varying amounts. A company making screw-machine products may find that the finished parts weigh only about 50% as much as the original bar or rod. The turnings are valuable, and should be sold back to the mill. Firms who stamp parts out of strip have been materially helped in many cases by the Revere Technical Advisory Service, which delights in working out specifications as to dimensions in order to minimize the weight of trimmings; nevertheless, such manufacturing operations inevitably produce scrap. Revere needs it. Only by obtaining scrap can Revere, along with the other companies in the copper and brass business, do the utmost possible in filling orders. You see, scrap helps us help you.

In seeking copper and brass scrap we cannot appeal to the general public, nor, for that matter, to the small businesses, important though they are, which have only a few hundred pounds or so to dispose of at a time. Scrap in small amounts is taken by dealers, who perform a valuable service in collecting and sorting it, and making it available in large quantities to the mills. Revere, which ships large tonnages of mill products to important manufacturers, seeks from them in return the scrap that is generated, which runs into big figures of segregated or classified scrap, ready to be melted down and processed so that more tons of finished mill products can be provided.

So Revere, in your own interest, urges you to give some extra thought to the matter of scrap. The more you can help us in this respect, the more we can help you. When a Revere salesman calls and inquires about scrap, may we ask you to give him your cooperation? In fact, we would like to say that it would be in your own interest to give special thought at this time to all kinds of scrap. No matter what materials you buy, the chances are that some portions of them, whether trimmings or rejects, do not find their way into your finished products. Let's all see that everything that can be re-used or re-processed is turned back quickly into the appropriate channels and thus returned to our national sources of supply, for the protection of us all.

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(*Continued from page 46*)

ing pipe sizes and wall thicknesses currently established as standard, plus what is believed to be a most complete tabulation of dimensional properties of commercially available sizes of steel pipe. Tube Turns, Inc.

232 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8 pp valve selection guide. Crane Co.

233 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. E. M. Dart Mfg. Co.

234 Flanges for Severe Service — This 4-pp bulletin describes a flange specially developed for services involving severe abrasion and corrosives, and for suction and discharge service. Goodall Rubber Co.

235 Pressure Reducing Valves — Selection and engineering data on pressure reducing valves, including those for remote control of reduced steam or water pressures, are presented in 12-pp Bulletin 477-A. Northern Equipment Co.

ELECTRICAL

236 Power Factor Correction — Examples showing basic considerations in the improvement of system power factor are contained in Bulletin O5B7465. Points out advantages of improving plant power factor and advisability of keeping load power factor up to 0.8 lagging or higher; tells how the effects of low power factor can be corrected. Allis-Chalmers Mfg. Co.

237 Co-ordinated Protection of Motors — The interlinked protection of circuits, motors and personnel is explained in 12-pp Bulletin DH-4673 on high-voltage combination starters. Because almost every 2300/4800 v power system can produce high currents under short-circuit conditions, booklet stresses this interlinked protection, covering three classes of combination motor starters. Westinghouse Electric Corp.

238 Care of A-C Rotating Equipment — To promote intelligent, consistent maintenance of electrical machines, company offers Bulletin O5R7417, a series of articles by Fraser Jeffrey. Contents of the 24-pp booklet cover preventive maintenance and machine repairs, drying moist insulation, measuring insulation resistance. Allis-Chalmers Mfg. Co.

239 Buyers' Manual on Motors and Control — Fifty-pp Catalog GEC-1009 presents buying information on a carefully selected group of motors, motor starters, control accessories and electronic control. Ratings listed are those most frequently required. Excellent data on proper selection is provided. Illustrated. General Electric Co.

PUMPS AND COMPRESSORS

240 Compressor Selection Chart — Based on normal applications handling air with atmospheric intake pressure, this chart simplifies selection of proper size compressor, giving quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute. Shows recommended compressor bore and stroke in inches. Worthington Pump and Machinery Corp.

241 Controlled Volume Pumping — Illustrated Bulletin 151, 24 pp, on controlled volume pumping will be of interest to engineers whose plant operations call for pumping a controlled volume of liquid in amounts from 3 ml per hour to 50 gpm. Describes features of company's pumps and includes data for selecting pumps for specific applications. 170 chemicals. Milton Roy Co.

242 Data on Pumps — All Types — Bulletins are available on centrifugal, reciprocating, screw and rotary pumps covering a wide range of capacities and services. Includes information on single and multi-stage, close coupled, single and duplex piston, and special pumps for handling erosive and corrosive liquids, also high viscosity liquids, both lubricating, non-lubricating. Warren Steam Pump Co., Inc.

243 Centrifugal Pumps — Twelve-pp Bulletin 715-1 presents manufacturer's support-head type centrifugal pumps, describing and illustrating construction details, and providing performance data, specifications and dimensions. These are single stage, ball bearing, enclosed impeller pumps for direct drive or belt drive; for general industrial use, water supply systems, booster service, air conditioning. Goulds Pumps, Inc.

INSTRUMENTS AND CONTROLS

244 For Centralized Control — Bulletin 109 presents compact Mini-Line equipment suited to control board arrangement which concentrates vital operating information and controls for one or more boilers, turbines or process units before a single operator. Describes and illustrates vertical-scale indicator units, selector valve, remote manual relay. Bailey Meter Co.

245 Putting the Ratio Totalizer to Work — Twelve applications of company's ratio totalizer in automatic control circuits are shown in 8-pp Bulletin 5450. This is a pneumatically operated control mechanism for combining input control pressures and spring forces to produce a single output control pressure. Hagan Corp.

246 For Practical Men — This 24-pp pocket-size booklet presents insulation testing in simple language. Packed with maintenance hints, explains electrical insula-

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A truly high-quality piston packing for steam, gas and oil under pressures up to 300 lbs. p.s.i., and temperatures to 425° F. Made of tightly woven asbestos, carefully finished, and lubricated with graphite.

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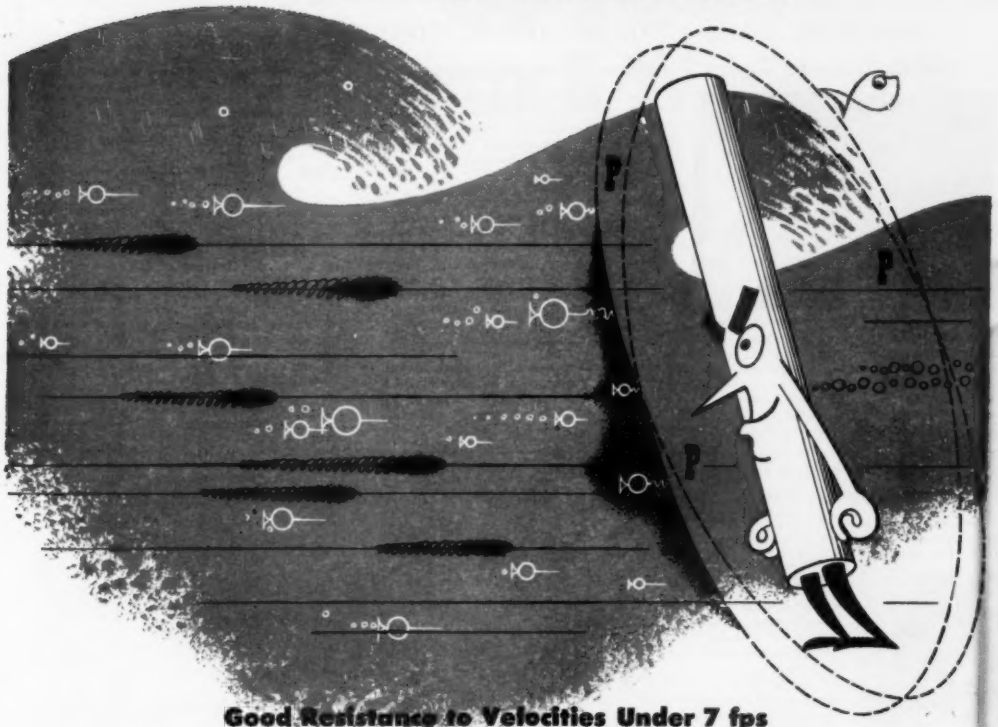
Why Phosphorized Admiralty Condenser Tubes?



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NUMBER 5 OF A SERIES

Instrument News

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Biddle Ground Tester measures low resistance

Photo Courtesy Copperweld Co.

In spite of apparently good lightning rod or arrester protection, lightning frequently will cause severe damage if high ground resistance hampers its dissipation in the earth. Lightning storms are prevalent in the northeastern states during the spring and fall months. Plants in this section should make a thorough round of ground resistance tests. Aside from the hazards to personnel, thousands of dollars may be saved in damage to electrical equipment and in loss of power and stoppage of production.

The MEGGER® Ground Tester is the easiest, quickest and most accurate method of determining ground resistance. It is an instrument specially designed for the purpose and should be used wherever possible. Direct readings are automatically obtained in ohms. It provides its own source of current—no batteries, or other remote source required. It's easy to carry, too. Has approval of the Associated Factory Mutual Insurance Companies.

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tion, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester and justifies its cost in long run economy. James G. Biddle Co.

247 Electronic Control System — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co.

248 Instruments, Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls and many others. Republic Flow Meters Co.

249 Control from a Distance — Eight-pp Bulletin 230-H4 describes company's Chronoflo Telemeter for transmitting information and controls over a simple two-wire electrical circuit for unlimited distances. Explains operation of transmitter and receiver, illustrates mechanism and installations. Builders-Providence, Inc.

250 For Feedwater Analysis — Bulletin 148 BP contains a technical discussion of manufacturers analysers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O_2 and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

251 Temperature Regulators — Twelve-pp Bulletin T, Catalog 80, describes manufacturer's line of regulators for controlling temperature of liquids and gases, giving their applications, operating characteristics, construction specifications, dimensions. Eight instruments are presented. Fully illustrated, includes selection and application chart. Foster Engineering Co.

252 For Determining Steam Consumption — Bulletin R-513 explains design, construction, installation and operation of manufacturer's rotary condensate meter, an economical means of determining steam consumption where all condensate can be captured. Includes size, dimension and weight table, simplified piping diagrams for both gravity, vacuum systems. American District Steam Co., Inc.

253 Pressure Regulator — Bulletin 1-B, 8 pp, discusses design, operation and applications of a super-sensitive pressure regulator; shows typical installations. Also covers a compound regulator for controlling back pressure relief valve and high pressure make-up valve. Atlas Valve Co.

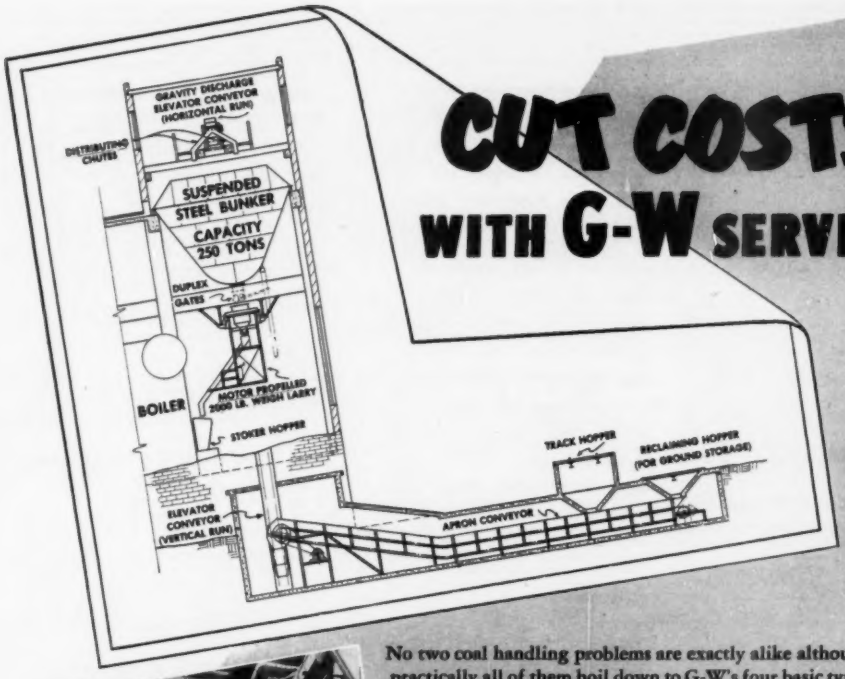
254 Steam Calorimeter — Bulletin 118 discusses an improved U-path calorimeter combining a throttling, separating and re-evaporating calorimeter in a single chamber. Explains construction and operation of the unit. Ellison Draft Gage Co., Inc.

PACKINGS

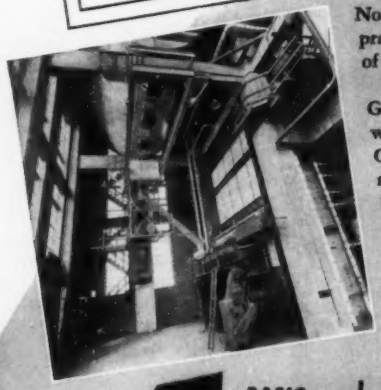
255 Pump Packings — Packings for reciprocating and centrifugal pumps are described in this folder. Covers packings for practically all services. Johns-Manville.

256 Long Wearing Piston Packing — Form 4502, 8 pp, stresses use of company's composition cups for packing the pistons of air and hydraulic cylinders and reciprocating pumps. Engineering information covers properties, textures, temperature, pressure data. Darling Valve & Mfg. Co.

257 Seals for Bearings — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes in detail mechanical pressure seals for rotary shafts. The Garlock Packing Company.



CUT COSTS WITH G-W SERVICE



No two coal handling problems are exactly alike although practically all of them boil down to G-W's four basic types of storage and handling.

For example, at a large U.S. Government arsenal, G-W designed and installed the suspended steel bunker with a gravity discharge bucket elevator shown at left. Coal is carried on the upper run of the conveyor, permitting free access to machinery and maximum bunker capacity. A cab-type weigh larry with recording beam provides clean, economical operation.

G-W conveyor system with capacity of 60 tons per hour. System consists of a Rail and Truck Hopper, a 30-inch Apron Conveyor, Gravity Discharge Elevator, 250-ton Suspended Steel Bunker and a 2000-lb. Weigh Larry.

4 BASIC WAYS TO CUT COAL HANDLING COSTS

No matter what your coal and ash handling problem is, from one of 4-basic types . . . Concrete Silos, Vitrified Tile Silos, Cylindrical Steel Tank, and Suspended Steel Bunker . . . G-W engineers can install the most efficient and economical storage and automatic handling system to fit your requirements of space, capacity and initial cost. Their recommendations to you, will be based on more than 140 years of design and engineering experience and on the performance records of hundreds of successful installations.

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6360

258 Metallic Packing — An elastic metallic packing for compressors, engines and pumps is described as to construction and advantages in this illustrated bulletin. Explains easy installation of the packing, illustrates reciprocating rod and rotating shaft installations. A. W. Chesterton Co.

259 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc.

FANS, BLOWERS

260 Mechanical Draft Fans — Mechanical draft fans for both forced and induced draft service are described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, includes performance curves showing efficiencies of various types of fans. Gives construction features, drive arrangements. The Green Fuel Economizer Co., Inc.

261 Axial Flow Blowers — In this 6-pp illustrated bulletin are described axial flow blowers of both turbine-driven and motor-driven types. Gives capacity and dimensional data, operating range and specifications on both types. L. J. Wing Mfg. Co.

BOILERS AND AUXILIARIES

262 Re-Circulation Steam Generator — Here's a 6-pp folder on a controlled re-circulation steam generator, describing its development and uses, such as applications where steam is required in remote locations, where demands are intermittent, or load fluctuating. Explains operation, features. Combustion Engineering-Superheater, Inc.

263 Packaged Generators — Bulletin SB-38 presents company's Keystone model. Photos and sketches show complete unit, pressure element and details of its compact design. Gives advantages of two-drum water boiler, three-pass gas travel, automatic gas or oil burner. Erie City Iron Works.

264 Shop-Assembled Boiler — Eight-pp Bulletin G-72 introduces company's new integral furnace boiler. Describes and illustrates its economy, ease of installation and connection, flexibility, minimum space requirements, efficient combustion, fast steaming. The Babcock and Wilcox Co.

265 Tube Expanders — Bulletin 380, 8 pp, covers manufacturer's line of tube expanders for maintenance of high pressure boiler tubes, superheaters, economizers, circulating tubes, steam generators, other equipment. Thomas C. Wilson, Inc.

266 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads, discussing special features. Roto Div., Elliott Co.

267 Streamlined Baffle Walls — Bulletin BW-44, 20 pp, describes company's baffle walls, showing their application to modern boilers and for modernizing existing units. Fully illustrated with photos and drawings covering installations, remodeling designs. The Engineer Co.

269 Soot Blower Head — Illustrated Bulletin 485 describes a rotary soot blower head for improved boiler cleaning. Explains how head is designed to give maximum blowing pressure, is rugged, easily serviced, economical. Vulcan Soot Blower Div., Continental Foundry & Machine Co.

270 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators and other applications. Discusses heat transfer properties, high temperature use. Also discusses prevention of galvanic corrosion. Bridgeport Brass Co.

COAL AND ASH HANDLING

272 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

273 Coal Scale — Bulletin 0250, 12 pp, describes a pressure-tight, automatic coal scale, its construction and operation. Shows how beam system, electrical components and linkages are protected from exposure to coal dust. Richardson Scale Co.

274 Ash Handling Systems — This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of arrangements under specific conditions, diagrams of arrangements included. Beaumont Birch Co.

275 Coal Handling Equipment — Modern equipment for the storage and handling of coal and ash is presented in 24-pp Bulletin 300. Illustrated, covers concrete and tile silos, cylindrical steel tanks, suspended steel bunkers. Gifford-Wood Co.

276 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

277 Efficient Coal Preparation — Facts on improved coal preparation

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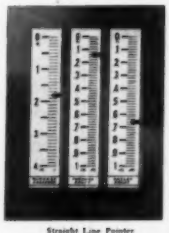

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219 W. KINZIE ST. Since 1896 CHICAGO 10, ILL.

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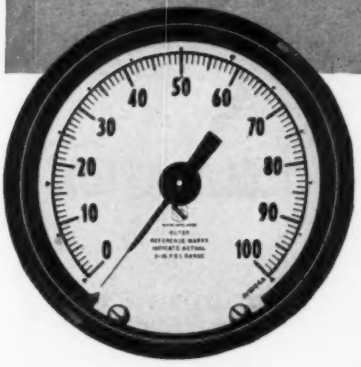

Duplex *Receiver* Duragauge—3½" Dial Size. Peripheral pointer is red.

Compact panelboard design demands pressure gauges that combine extreme accuracy with smaller size, easy-to-read dials. *The new Ashcroft Receiver Duragauges, with 3½" dial, meet those requirements exactly.*

Wherever pneumatic transmission and control systems are used to indicate pressure, temperature or flow—in power plants, refineries, chemical plants—these new *Receiver* Duragauges provide *accuracy within ½ of 1 percent of the dial range.* Standard transmitted air pressure range is 3 to 15 P. S. I. Other ranges include 2 to 14, 2 to 15, 3 to 18 and 5 to 25 P. S. I.

Single and Duplex *Receiver* Duragauges are available. The Duplex incorporates two separate sets of Bourdon tubes, movements and pointers. Bourdon tube material is heat-treated phosphor bronze, extra wide for extreme sensitivity, with long tip travel for precision accuracy.

Get complete data, including dimensions and standard graduations. Your Ashcroft Distributor will gladly help you select the right *Receiver* Duragauges for your specific needs.

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MAKERS OF 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

for power plants are presented in this 8-pp illustrated booklet. Shows how coal is split, not crushed, by rolling ring principle utilized in company's equipment to provide better combustion and reduced ashpit loss through uniform low-cost coal sizing. American Pulveriser Co.

278 Single-Retort Stokers — Catalog 350, 28 pp, is devoted to manufacturer's LoStoker, a complete mechanical firing unit for burning various grades of bituminous coal with high efficiency. Text and pictures cover operation, design and application of these single-retort stokers. Several installations are shown. Sizes, capacities given. Detroit Stoker Co.

COOLING

280 Heat Exchangers — Bulletin 11.0-080 describes air cooled heat exchangers for condensing or cooling of steam or process vapors, natural gas, jacket water, lubricating oil, quenching baths. Equipment Div., J. F. Pritchard & Co.

281 Cooler with Fins — A new oil and water cooler and advantages of its improved design are described in 20-pp Bulletin 1020. Explains how company's LK-Fin Cooler, distinguished by use of helically-finned heat transfer elements instead of bare tubes, is a lighter, more compact and less costly unit. Diagrams show comparisons of length and number of tubes and size of units for equivalent heat transfer surface. The Griscom-Russell Co.

282 Heat Exchangers — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Niagara Blower Co.

283 Cooling Towers — Bulletin AQ-50 is on packaged water cooling towers in 3 to 50 t sizes. Gives specifications for the tower and discusses special features. Also provides dimensional and application data. The Marley Co., Inc.

284 Spray Nozzle Systems — Recooling spray nozzle systems for use in plants operating condensers or using large quantities of water for cooling, are covered in 8-pp Bulletin 6A-SP. It details design, application, construction, and operation of spray nozzles, and diagrams typical spray pond arrangements. Sizes, dimensions, capacities, and spray nozzle patterns are included in tabular form. Includes cooling performance curves for various temperature ranges. Schutte and Koerting Co.

COMMUNICATIONS

285 Civil Defense Communications — Form G93-122, 12 pp, pictures typical communications systems now in use which can be coordinated into a dependable emergency communications network in any community. Describes company's technical advisory service for civil defense radio communications and lists district representatives available to analyze existing systems and form them into a single emergency network. Electronics Dept., General Electric Co.

286 Power Plant Intercom System — A communication system custom tailored to individual plant conditions and designed for two-way conversation over microphones and receivers, as well as paging, is described in this 25-pp booklet. Text tells how system is easily installed and is adapted to different noise levels of a power plant. Photos show installations of paging equipment. Gai-Tronics, Inc.

CONDENSERS

287 Steam Condensers with Reserve Flow — Eight-pp Catalog 410-1 describes a "self-cleaning" reverse-flow condenser for power plant service, designed to virtually eliminate cleaning downtime and, in the case of divided water box condensers, eliminate operation at partial load. C. H. Wheeler Mfg. Co.

289 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures, steam nozzles, condensing water, raw water cooling, recirculation and removal of condensate. Foster Wheeler Corp.

290 Steam Condensers — Bulletin 102, 24 pp, presents manufacturer's steam condensers and includes photos of typical installations as well as engineering data, discussion of air removal equipment, and chapter on condenser maintenance. Company's Wizard injector to seal small leaks while condenser is in operation, air erosion eliminators, divers lights and port gages are also described. Condenser Service & Engineering Co., Inc.

TURBINES, GENERATORS

292 Multi-Stage Turbines — Six-pp Bulletin S-147 describes two of company's smaller-frame multi-stage turbines, both of the impulse type. Construction details are illustrated and described in detail. The Terry Steam Turbine Co.

293 Turbine Generators — Bulletin H-18, 40 pp, covers turbine-generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings showing a typical turbine condenser installation arrangement. Elliott Co.

REFRACTORIES, INSULATION

294 Refractory Brick — Electric furnace fused refractory bricks and their use in described in Form 862, 16 pp. Gives installation procedure on a high quality silicon carbide brick for boiler furnaces and gas generators. Also describes a fused aluminum brick of high refractoriness. Fully illustrated. Norton Co.

No Water Hammer! No "Hunting!"
DAVIS No. 60 FLOAT VALVE

The Davis No. 60 Float Valve, illustrated here, is unexcelled for dependable performance. It handles either hot or cold water with no "hunting," no "water-hammering." Opens easily against any pressure up to 125 p.s.i. and closes positively drip tight. No sticking; there is no internal packing to swell and cause excessive friction. Built in sizes ½" to 12". Standard construction — composition disc, bronze trim. All bronze or stainless trim available. Contact your distributor or write.

No. 60

- Single seat; pilot stem.
- Tight closing; non-sticking.
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A NEW MEMBER OF THE INCO FAMILY INCOLOY

Incoloy is a wrought nickel-chromium-iron alloy, developed as a nickel-saving companion to Inconel. It is a high temperature material with good resistance to oxidation, strength at elevated temperatures and workability comparable to that of Inconel.

The principal engineering characteristics of Incoloy are:

- **Oxidation Resistance** – the oxidation resistance of Incoloy is of the same order as Inconel. It has a chromium content of 21%.

INCOLOY
Mechanical Property Ranges of Standard Forms at Room Temperature

Form & Condition	Tensile Properties: Tensile Strength 1000 psi	Yield Strength (0.2% Offset) 1000 psi	Elongation in 2 in. per cent	Hardness: Brinell 3000 kg	Hardness: Rockwell
Rod and Bar					
Cold-drawn					
Annealed	75-100	30-55	50-30	120-170	66-86B
As-drawn	100-150	80-125	30-10	180-290	90B-30C
Hot-Rolled					
Annealed	75-100	30-55	50-30	120-170	66-86B
As-rolled	80-120	35-90	50-25	135-220	74-96B
Forged	80-120	35-90	50-25	135-220	74-96B
Wire					
Cold-drawn					
Annealed	75-105	25-55	50-25	.....	.....
Plate					
Hot-rolled					
Annealed	75-105	30-55	50-30	120-180	.....
As-rolled	80-120	35-90	50-25	135-220	.....
Sheet					
Cold-rolled					
Annealed	75-100	30-55	50-30	.....	88B (max.)
Deep drawing and spinning quality	75-100	30-45	55-35	.....	80B (max.)
Strip					
Cold-rolled					
Annealed	75-100	30-50	50-30	.....	84B (max.)
Deep drawing and spinning quality	75-100	30-45	55-35	.....	80B (max.)
Tubing					
Cold-drawn					
Annealed	75-100	30-55	50-30	.....	88B (max.)

- **Expansion co-efficients**—The expansion co-efficients are approximately those for Inconel. Thus Incoloy should have about the same high temperature resistance to cracking under drastic temperature changes. Because of its relatively high nickel content (34%) the structure of Incoloy is stably austenitic showing no tendency to become embrittled by precipitation of sigma or carbidic phases after prolonged exposure to intermediate temperatures.

- **Room temperature properties** – Room temperature mechanical property ranges of Incoloy mill forms are shown in the table on the left:

- **High Temperature Properties** – High temperature strength properties of Incoloy are comparable to those of Inconel.

In terms of behavior in various high temperature environments it is anticipated that Incoloy will be superior to Inconel in resistance to sulfidation, green-rot and molten cyanide salts. Incoloy is comparable to Inconel in resistance to oxidation.

- **Work Hardening**—The rates of work hardening of Incoloy and Inconel are practically identical.

- **Annealing** – Annealing temperatures for Incoloy should be within the range of 1800° F. to 2000° F.

- **Fabrication**—Incoloy is workable, both hot and cold. It is machinable, though high-speed steel tools should be used.

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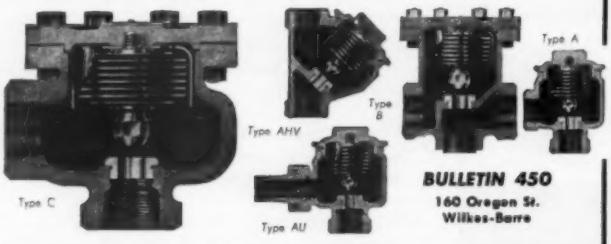

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298 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, with tube bundles removable. Davis Engineering Corp.

299 Fundamentals of Hydraulics — Technical Bulletin B-4, 44-pp covers hydraulic systems, maintenance trouble-shooting and selection of proper fluids. Besides offering reference data to engineering personnel, this book is suggested as a training manual for maintenance supervisors, operators. It features phantom and cutaway drawings illustrating functions of basic types of valves, pumps, hydraulic motors, torque converters. Sun Oil Co.

300 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. Discusses steam and oil control valves. National Airoil Burner Co., Inc.

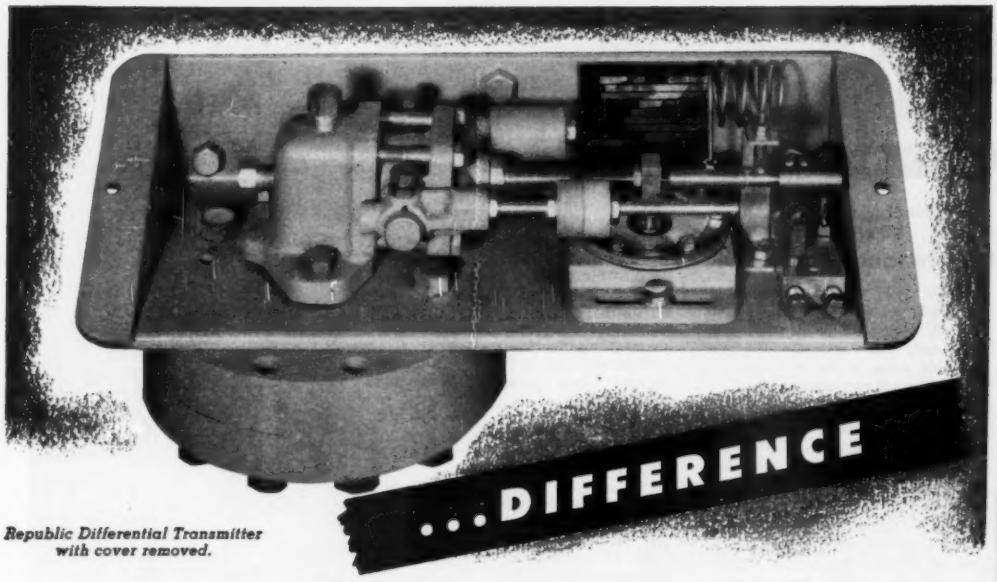
301 Air Preheaters — Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Provides general description of company's preheater, discusses its application to boiler plants. The Air Preheater Corp.

302 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

303 One-Minute Water Tests — Rapid, simple and accurate tests for determining water hardness are described in Bulletin 1RE50. Procedures, reagents, and equipment are described. Tells how tests determine water hardness, hardness due to calcium alone and hardness due to magnesium alone. Hall Laboratories, Inc.

304 Bibliography on Nickel Alloys — Sixteen-pp List A covers company's technical papers and commercial publications available on nickel alloy steels, stainless steels, nickel cast irons, nickel brasses and bronzes, and nickel plating, and their uses. The International Nickel Co., Inc.

305 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, tables on superheat correction factor. Manning, Maxwell & Moore, Inc.



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AMERICAN Society for Engineering Education is issuing a call to industry, the professional societies, public or private research organizations, and the engineering colleges for teaching aids which may be reviewed in its forthcoming Catalog of Teaching Aids. This publication, which is being prepared by the Society through its Committee on Teaching Aids, will contain reviews of all kinds of teaching aids suitable for use in the teaching of various engineering subjects.

First edition of the catalog will be limited to civil, electrical, and mechanical engineering, mathematics, and engineering mechanics. This edition will also be limited to motion picture films (sound and silent), slides in 2 by 2-in. or 3¼ by 4 in. size, models, charts, and exhibits. Information on such devices should be sent to Professor Carl W. Muhlenbruch, Chairman ASEE Committee on Teaching Aids, Northwestern Technological Institute, Evanston, Illinois, who will see that they reach the proper reviewing group. Each offer of a teaching aid should be accompanied by a written description or photograph and a set of operating instructions.

The chief purpose of the ASEE Catalog of Teaching Aids will be to help the engineering teacher choose teaching aids that most suit his particular needs and to provide him with the assurance that they have been passed upon by competent individuals. The catalog, to be sold at a nominal price, will include a brief description of each teaching aid and a review prepared by a committee of three qualified educators in the field for which it is intended. The listing will also indicate where the device may be obtained, its dimensions, important physical characteristics, any charge for its use, and other detail information which the prospective user would require.

Types of Teaching Aids Needed

The Committee asks that teaching aids, not "training aids", be submitted for review in the catalog. The training aid has its uses in teaching workers in industry how to perform certain manual operations, but in educating engineers it is necessary to provide the student with an understanding of the fundamentals of the subject being studied. For this reason the training aid is not applicable to engineering education. Instead, what is needed are teaching aids, which enable the student to grasp more quickly the fundamentals of the science of engineering and then to apply them to the solution of actual problems.

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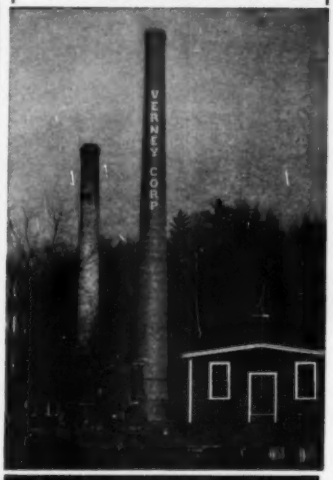

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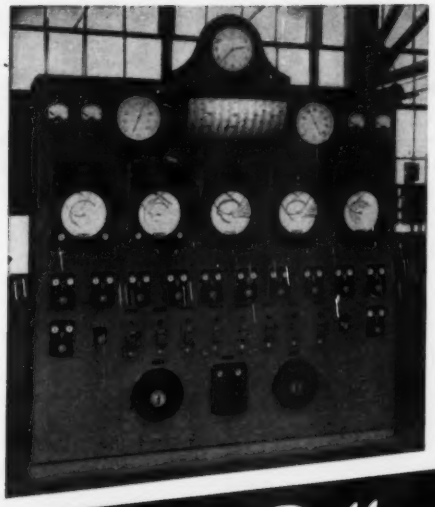

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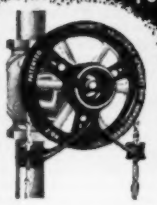

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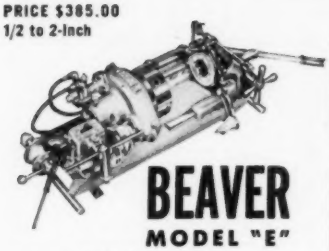

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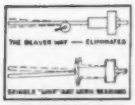

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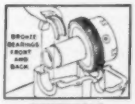

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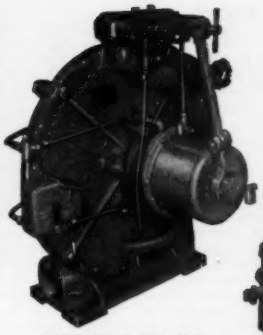
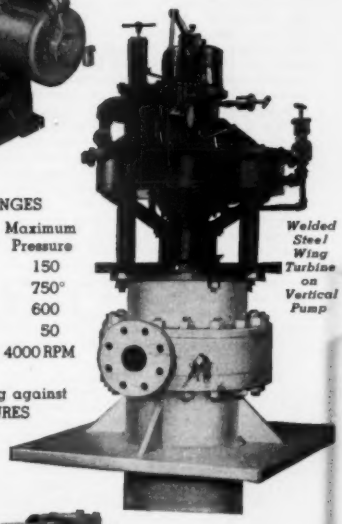




Welded Steel Wing Turbine on Vertical Pump

OPERATING RANGES

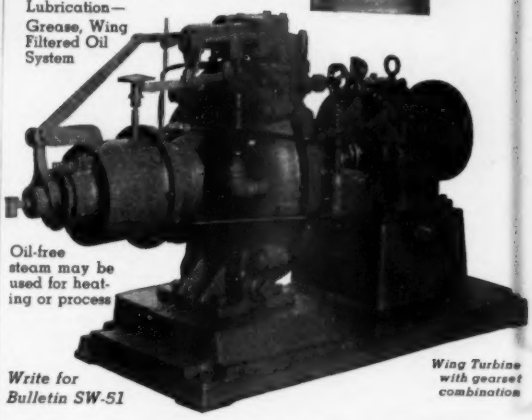
	Standard	Maximum Pressure
Horsepowers	100	150
Temperatures	525°	750°
Pressures	275	600
Back Pressures	50	50
Speeds	4000 RPM	4000 RPM

Capable of exhausting against HIGH BACK PRESSURES

Shafts—Horizontal or vertical

Rotation—Clockwise or counter-clockwise

Lubrication—Grease, Wing Filtered Oil System



Oil-free steam may be used for heating or process

Wing Turbine with gearset combination

Write for Bulletin SW-51

L. J. Wing Mfg. Co. 64 Vreeland Mills Rd.
Linden, New Jersey
Factories: Linden, N. J., Montreal, Canada

Wing
AUXILIARY STEAM TURBINES

NEW ENGINEERING BOOKS

(*Continued from page 118*)

the early days of World War II. Even as its pages came from the presses, Fermi and his cohorts were busy in Chicago fashioning that historic structure of graphite and uranium which was to herald the birth of the atomic age and broaden tremendously the potential applications of nuclear science. Thus, as the authors point out in the preface of this Second Edition, the same act that gave muscle and sinew to applied nuclear physics signaled obsolescence for the book almost at the time of its appearance.

The present edition represents an effort on the authors' part to remedy this situation. A new chapter on nuclear chain reaction has been added. Special sections have been devoted to pile theory, neutron diffraction, cross-sections and cosmic rays. Also included for the first time are detailed instructions to guide the reader who may wish to perform a number of informative laboratory experiments in nuclear physics. Also, the tables of nuclear data have been brought up to date. Much of the subject matter common to both editions has been rewritten and expanded in the light of advances of the past eight years.

In simple, concise language this book gives a clear picture of practically all phases of nuclear science, including the basic facts of nuclear particles and radiations and methods of accelerating them, transmutation, natural and artificial radioactivity, isotopy and nuclear physics.

Anyone interested in the subject of nuclear physics should find this book both interesting and valuable.

How to Read for Self-Improvement, by Frank K. Levin; 246 pages plus study guide; size 5 by 8 in.; cloth binding; illustrated; published by American Technical Society, Drexel Avenue at 58th St., Chicago, 37, Ill.; price $2.75.

This book is intended to improve your reading ability. The author tells you in non-technical language, with a working plan, supplemented by a study guide and answers to study guide questions, how to greatly increase your reading speed, improve your retention of what you read, enrich your enjoyment and add to the many values to be obtained from reading.

The author points out that reading is a skill so closely allied to a person's capacity for leadership that its importance cannot be over-emphasized.

He begins by talking about how to learn from books, making every minute count and making a book more valuable to yourself. He gives ways to improve your memory, how to read for tests and examinations and how to increase your reading speed and improve comprehension. A very interesting chapter stresses the best way to learn mathematics and science. There is a chapter on vocabulary and composition, another chapter on the best way to read about a certain profession or trade or field. The final chapter begins with this sentence: "The best that may be said of reading is that there is never an end to it, that for every accomplishment there is a new beginning. Somebody has said that democracy is unfinished business; so is reading for self-improvement."

Gas Turbine Plant Heat Exchangers, by W. M. Kays, A. L. London, and D. W. Johnson; 75 pages; size 8½ by 11 in.; paper binding; published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.; price $3.00.

Before 1946 most of the available basic heat transfer and flow friction data for gas-to-gas heat exchanger design related to banks of circular tubes. However, other types of tubes were later developed and this book discusses not only tubular surfaces but plate fin surfaces, louvered fins and ruffled fins, and fin flat tube surfaces.

Following an introduction and discussion of experimental methods used, there is an analysis of heat exchanger heat transfer and flow friction. Section IV deals with heat transfer surface geometry; Section V gives design data, with many tables of the various factors and a number of charts, while Appendix I discusses properties of air, air water vapor mixture and combustion products and Appendix II gives examples of heat exchanger performance calculations.

Although just at present the data and calculation methods given in this publication are of interest to only a relatively few engineers, still it is very important to have these data available for those few. Moreover, in the light of many present developments in various industries many of the methods and data may be useful outside the gas turbine field. And, finally, as the years go on, more and more engineers will have to become interested in the gas turbine itself and will have to study this part of the subject more intensively. To do so, they will need to use considerable mathematics, so they'd better begin to brush up on their advanced algebra and calculus, if they plan to be at all interested in the gas turbine.

Elementary Pile Theory by Harry Soodak and Edward C. Campbell. First Edition; 73 pages; illustrated; 5⅝ by 8 ⅛ in.; published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y.; 1950; price $2.50.

This is an excellent little book for those who are seriously interested in the theory underlying the operation of atomic reactors. Its title, however, should not mislead one. While Elementary Pile Theory presents the fundamental ideas associated with the chain reacting pile, it is not in any sense of the word to be considered a popular book. It is essentially a mathematical consideration but the authors have kept the mathematics as simple as possible, consistent with the complexity of the subject. The authors report on detailed investigations of what happens to the fast neutrons given off in the act of fission, how they move about in space, and how they are slowed down in matter. To avoid complications, only homogeneous piles are treated and they are considered from the point of view of simple diffusion theory.

The book contains the declassified material of a series of lectures given by Dr. Soodak in connection with the Clinton Laboratories Training Program. The lectures were delivered to a limited number of academic and industrial physicists, chemists and engineers. While the pages of this little book represent only a small though very significant part of the training program, the information in it is now available to all interested scientists and engineers.

Modern Oscilloscopes and Their Uses by Jacob H. Ruiter, Jr. First Edition; 191 pages; illustrated; size 6 by 9 in.; cloth; published by Murray Hill Books, Inc., 232 Madison Ave., New York, N. Y.; 1950; price $6.00.

This book by the Advertising Manager of the Instrument Division and Manager of Technical Publications of the Allen B. DuMont Laboratories, Inc., is the first comprehensive book on oscilloscopes directly aimed at the needs of radio and television servicemen, as well as engineers in many fields of industry.

Starting with a discussion of what the oscilloscope is, what it consists of and examples of the various functions it performs, the book progresses logically to the operation of the cathode ray tube which is the indicating device employed in the oscilloscope. Then the operation of the oscilloscope is explained with detailed information on each element. Power supplies, amplifiers, attenuators, positioning and timebase circuits and controls. The interpretation and use of basic patterns obtained with the oscilloscope are made clear by means of carefully prepared drawings.

Next the book explains how the oscilloscope is used as a timesaving industrial device, as a visual aid in teaching, etc. Of particular interest is the material describing the techniques for photographing patterns from the screen of the cathode-ray tube. Throughout the book presents the most useful information in a clear manner that can be readily understood by anyone who has had elementary electronics training.

Ion Exchange Resins, by Robert Kunin and Robert J. Myers; 213 pages; 104 illustrations; size 6 by 9 in.; cloth binding; published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y.; price $4.75.

One of the important developments of the last few years, to which many references have been made in POWER ENGINEERING, is the development of ion exchange resins, used principally in this field in the treatment of boiler feedwater. This is the first book to assemble, digest and clarify the essential parts of the voluminous literature on this increasingly important subject.

As readers of this magazine are aware, the use of ion exchange resins in boiler feedwater treatment is increasing rapidly. They are used in various combinations, sometimes alone and sometimes in connection with other methods of water treatment, the object being to produce feedwater as pure as possible. In the latest forms in which they have been used, together with other treatment processes, they have helped greatly in producing a water which, for all commercial purposes, is the equivalent of distilled water.

The book covers very thoroughly the way in which these ion exchange resins work, including the underlying theory, the usefulness of the resins, the operation and engineering data associated with them and methods of using them, not only in the laboratory, but in industry. The authors are members of Rohm and Haas Co., which has been one of the principal organizations instrumental in developing various types of ion exchange resins.

The book brings together the essence of a tremendous amount of technical literature, mostly in the various technical and scientific magazines published during the past few years, and there is a list of 615 of these at the end of the book.

The subject is treated under following chapter headings: Introduction and Historical Review; The Theory and Mechanism of Ion Exchange; Cation Exchange Resin Characteristics; Anion Exchange Resin Characteristics; The Synthesis of Ion Exchange Resins; Applications, General Considerations; Water Softening by Ion Exchange; Deionization of Water and Other Electrolyte Solutions; Ion Exchange in Analytical Chemistry; Miscellaneous Applications; Methods of Studying Ion Exchange Resins; The Design of Ion Exchange Units.

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